INTRODUCTION

This Handbook covers all maintenance instructions from minor adjustments, test and inspections to major disassembly and repair (except structural repair) for all P-40N series airplanes in the following blocks:

P-40N-1-CU	AF42-104429 through AF42-104828
P-40N-5-CU	AF42-104829 through AF42-105928
P-40N-10-CU	AF42-105929 through AF42-106028
P-40N-15-CU	AF42-106029 through AF42-106405
P-40N-20-CU	AF42-106406 through AF42-106428 and AF43-22752 through AF43-24251

The following technical orders form a part of the complete instructions for operation, maintenance, and repair of the P-40N series airplanes:

01-25C-3	Structural Repair Instructions—P-40 Series
01-25C-4	Airplane Parts Catalog—P-40M and P-40N
01-25CN-1	Pilot's Flight Operating Instructions—P-40N
01-25CN-30	Cold Weather Operation and Maintenance Instructions—P-40N Series

DEMO dimensione ridotta

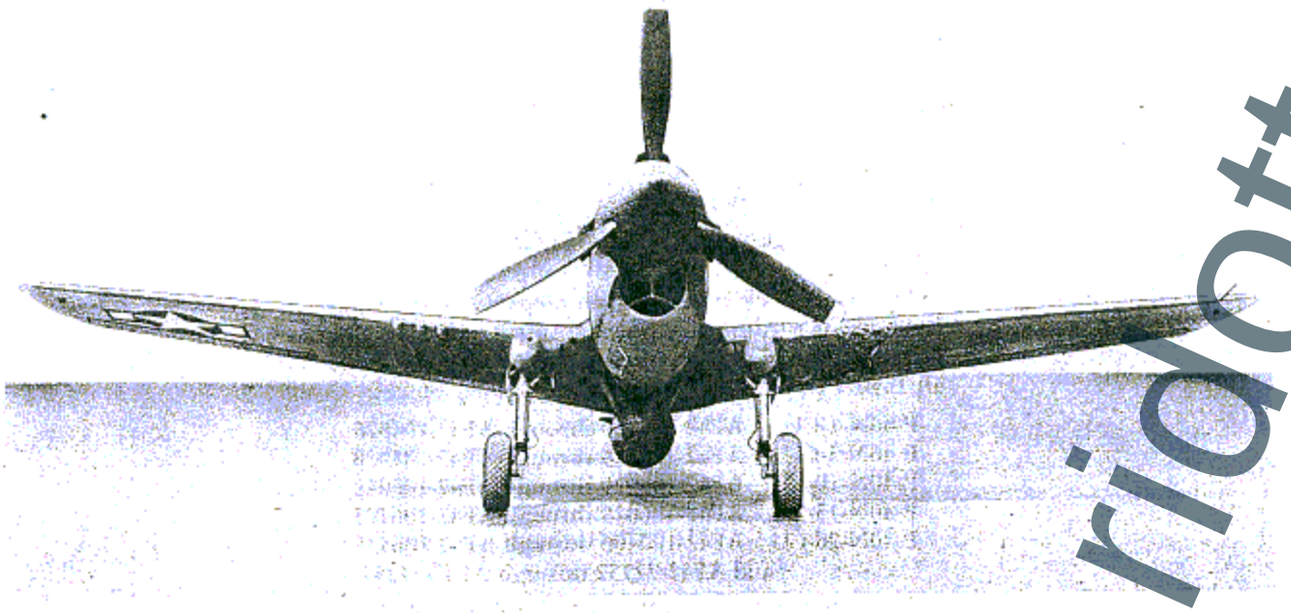


Figure 1—Front View of P-40N Airplane

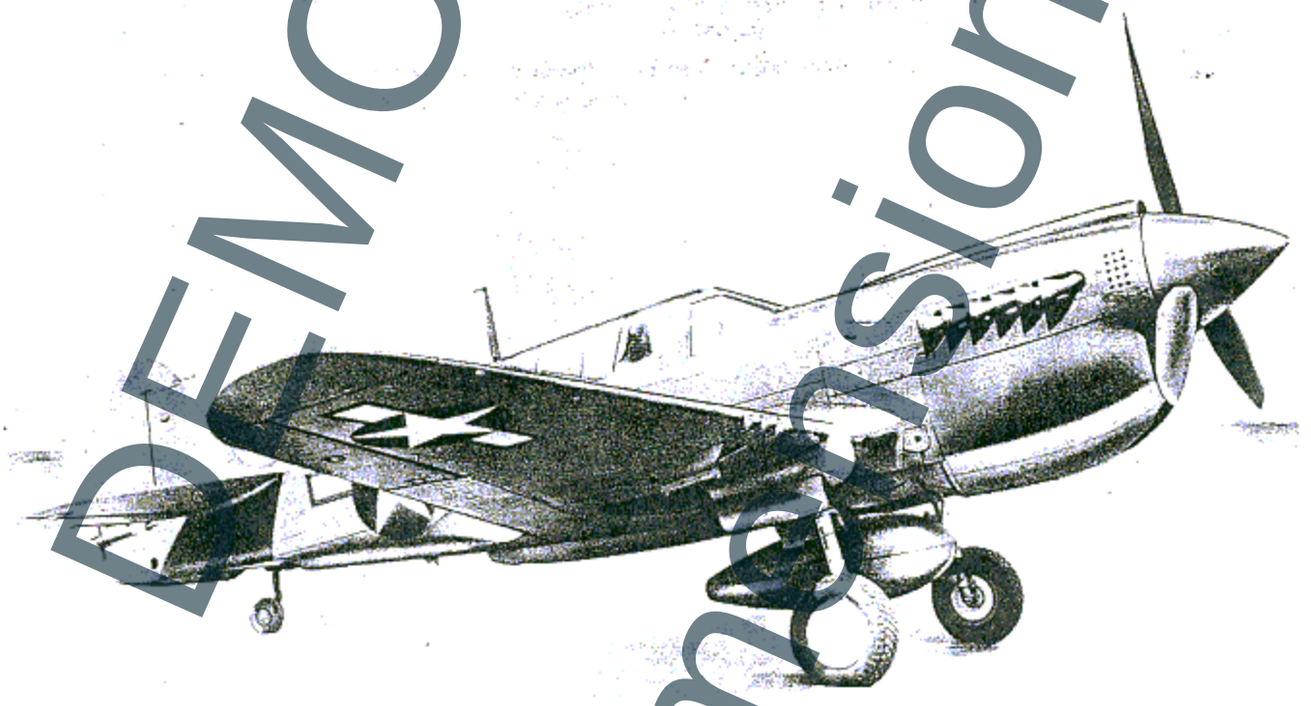


Figure 2—One-Quarter Right Front View of P-40N Airplane

DEMO
dimensione ridotta

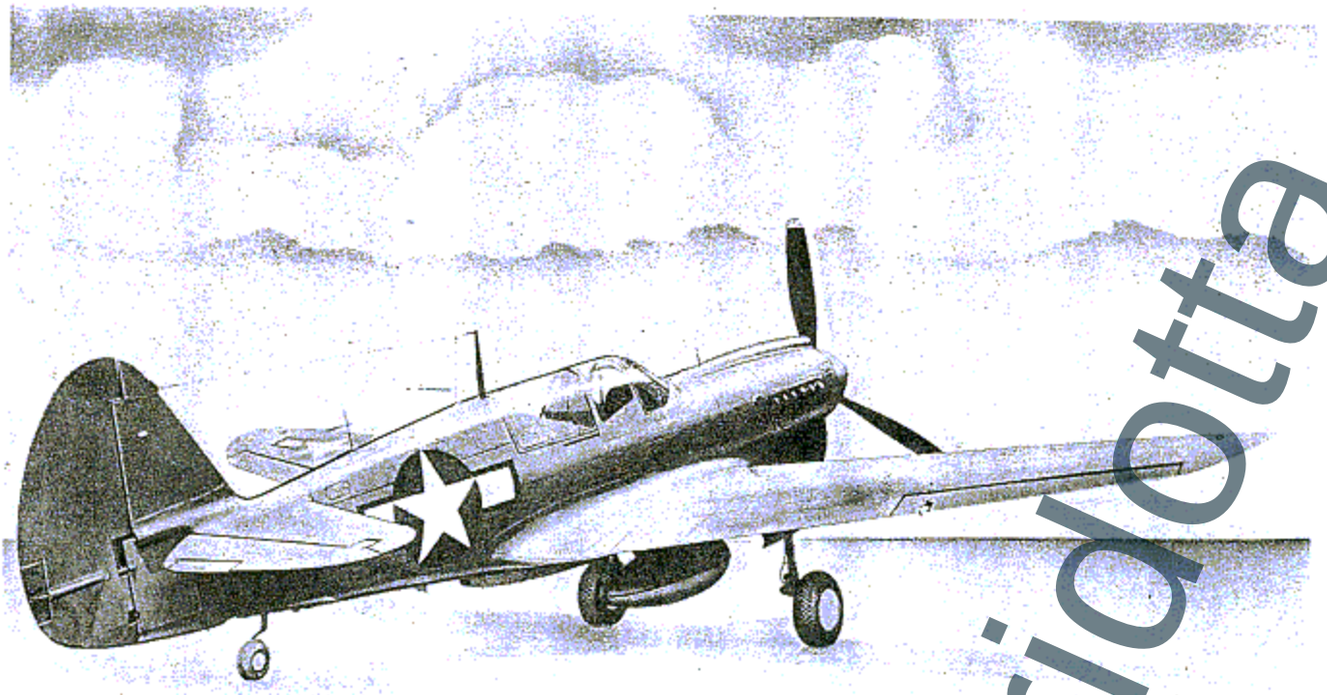


Figure 3—Three-Quarter Right Rear View of P-40N Airplane

Figure 4—Rear View of P-40N Airplane

DEMO dimensione ridotta

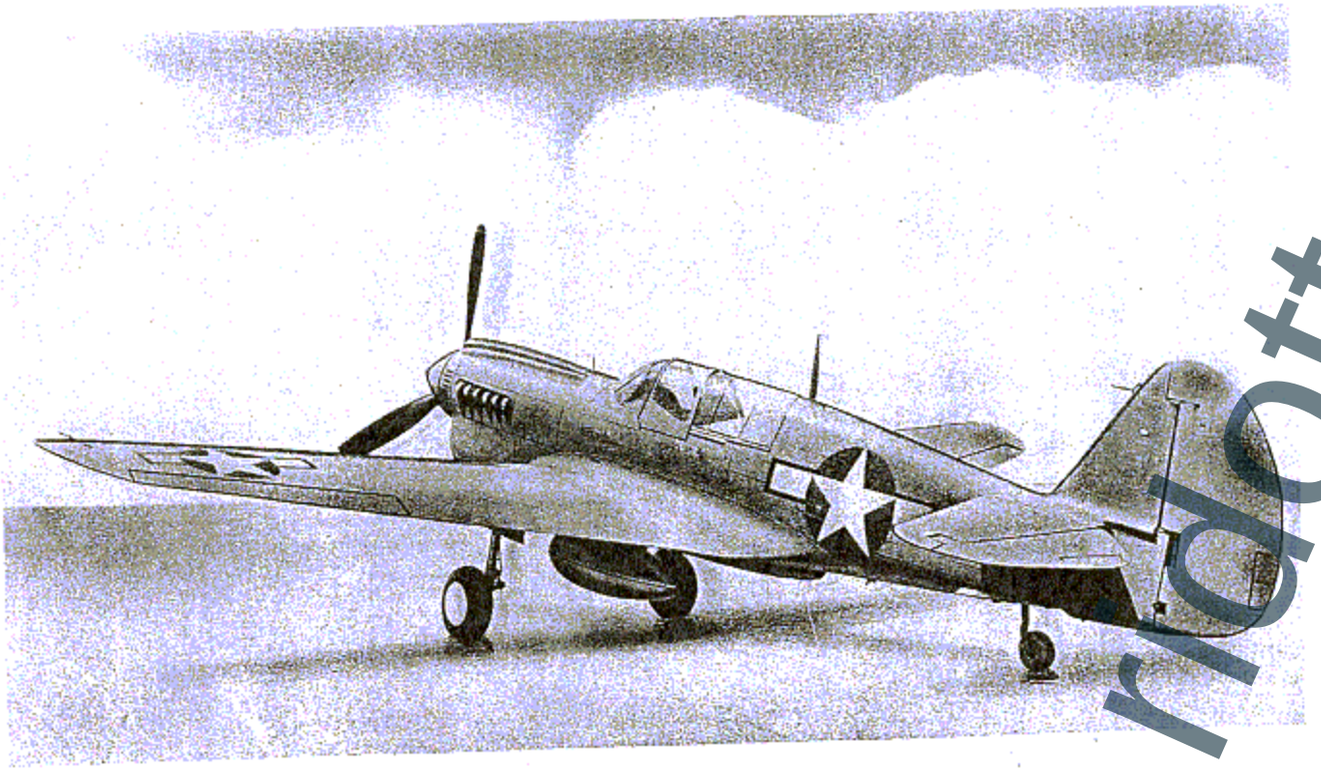


Figure 5—Three-Quarter Left Rear View of P-40N Airplane

Figure 6—One-Quarter Left Front View of P-40N Airplane

DEMO
dimensione ridotta

TABLE OF CONTENTS

DEMO dimensione ridotta

DEMO dimensione ridotta

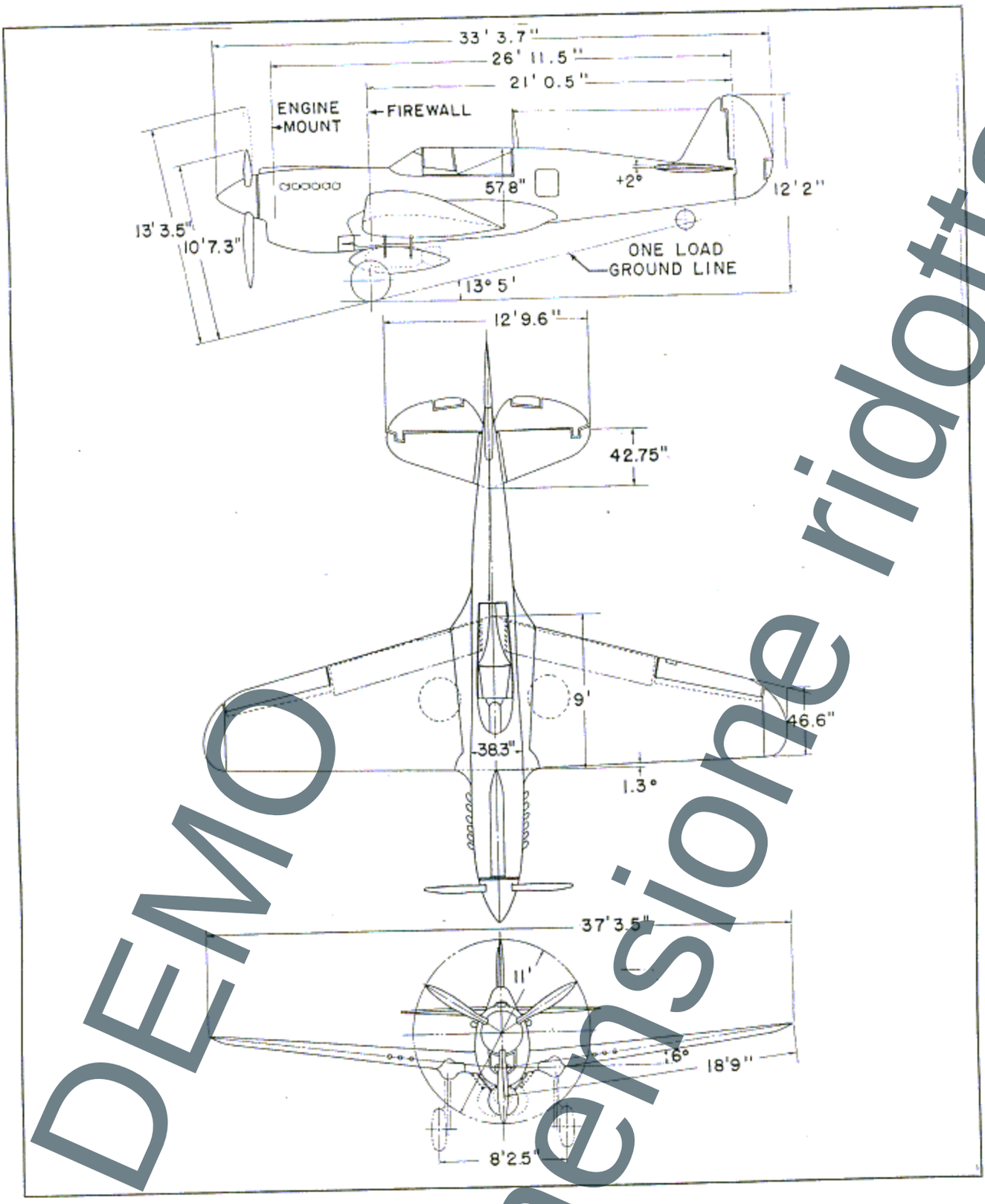


Figure 7—Three View Dimensions

DEMO dimensione ridotta

SECTION I
DESCRIPTION, DIMENSIONS AND LEADING PARTICULARS

1. DESCRIPTION

The P-40N airplane is a single seat, low wing monoplane, designed for medium altitude pursuit and interception of hostile aircraft. It is powered with one 12-cylinder V-1710-81 (F-20R) Allison engine for airplanes AF42-104429 through AF42-106405, and one 12-cylinder V-1710-99 (F-26R) Allison engine for airplanes AF42-106406 and subsequent. Its armament consists of six .50 caliber machine guns. All guns fire outside the propeller disc.

2. DIMENSIONS.

Figure 7 gives the principal overall dimensions with the airplane in normal position at rest.

3. LEADING PARTICULARS.

The principal dimensions and data pertaining to the airplane are given in the following table:

PRINCIPAL DIMENSIONS

(Aircraft in level flight position unless otherwise stated.)

GENERAL	
Span	37 ft 3.5 in.
Length (overall)	33 ft 3.7 in.
Height	12 ft 7 in.
Height (tail wheel on ground, propeller blade vertical at top)	13 ft 3.5 in.
WINGS	
Airfoil Section (curve identification)	
N.A.C.A. 2215 at root	
N.A.C.A. 2209 at 197 in. from fuselage center line	
Chord at root	9 ft
Chord at wing tip	46.6 in.
Incidence	+ 1°
Dihedral (measured at leading edge of wing)	6°
Sweepback	1.3°
STABILIZER	
Span	12 ft 9.62 in.
Maximum Chord	42.75 in.
Incidence	+ 2°
FUSELAGE	
Width (maximum)	38.32 in.
Height (maximum)	57.81 in.
Length (without engine mount)	21 ft 0.5 in.
Length (with engine mount)	27 ft 11.5 in.

AREAS

WINGS (less ailerons)	217.70 sq ft
WINGS (total)	236 sq ft
AILERONS (total)	18.3 sq ft
FLAPS (total)	34.8 sq ft
STABILIZERS (including elevators)	30.86 sq ft
ELEVATORS (two) (including tabs)	17.44 sq ft
ELEVATOR TRIM TABS (total)	1.68 sq ft
FIN	7.0 sq ft
RUDDER (including tab)	13.74 sq ft
RUDDER TRIM TAB	.55 sq ft

SETTINGS AND RANGES OF MOVEMENT OF CONTROL SURFACES

STABILIZER	2° up from thrust line
FIN, OFFSET (measured from fuselage center line)	0°
AILERONS	
Up (from neutral)	18-3/4°
Down (from neutral)	10-1/2°
FLAPS	
Up	0°
Down	45°
ELEVATORS	
Up (from streamline with stabilizer)	30°
Down (from streamline with stabilizer)	20°
RUDDER	
Right (from streamline with fin)	30°
Left (from streamline with fin)	30°
TRIM TABS	
Elevators—Up (from elevator trailing edge)	3° ± 1°
Down (from elevator trailing edge)	26° ± 1°
Rudder—Right (from rudder trailing edge)	15° + 5° − 2°
Left (from rudder trailing edge)	15° + 5° − 2°
Aileron (AF42-104429 through AF43-24251)	
Left (fixed type)	Bent to suit on ground
Right (fixed type)	Bent to suit on ground

DEMO dimensione riplotta

Aileron (AF43-24252 and subsequent)	
Left (one fixed and one electric type)	Fixed type, bent to suit on ground; electric type, adjusted electrically from cockpit.
Right (fixed type)	Bent to suit on ground
TOLERANCE ON CONTROL SURFACE MOVEMENTS, UNLESS OTHERWISE SPECIFIED	± 2°

ALIGHTING GEAR

WHEEL TYPE ALIGHTING GEAR	
Type	Hydraulically retractable
Tread (width from center of tire to center of tire)	8 ft 2.5 in.
Shock Struts (main)	
Type	Single strut, pneumatic oleo
Part No.	87-311-1000 (for 27-inch wheels) 87-31-910-10 (for 30-inch wheels)
Fluid Required	
Trade name identification (commercial)	Lockheed No. 5
AAF Specification	3586
WHEELS (main) (For airplanes AF42-104429 through AF42-104828)	Hayes
Type	Hayes, 30 inch smooth contour drop center rim type, part No. H-3-159A
Tire	30 inch, 8-ply Nylon casing, smooth contour, drop center type.
Tire Pressure	Inflate to inflation mark
WHEELS (main) (For airplanes AF42-104829 and subsequent)	
Type	Hayes, 27 inch smooth contour, drop center rim type, part No. G-3-297M
Tire	27 inch, 8-ply Nylon casing, smooth contour, drop center type
Tire Pressure	Inflate to inflation mark
BRAKES	
Type	Hayes reversible, hydraulically operated, single shoe
TAIL WHEEL	
Type	Hydraulically retractable
Shock Strut	
Type	Single strut pneumatic oleo
Part No.	87-37-510
Fluid Required	
Trade name, identification (commercial)	Lockheed No. 5
AAF Specification	3586
WHEEL	
Type	Firestone 12.5 in. diameter, smooth contour, part No. CO 220-M
Tire	12.5 in. diameter, 6-ply rayon smooth contour static conductor
Tire Pressure	Inflate to inflation mark

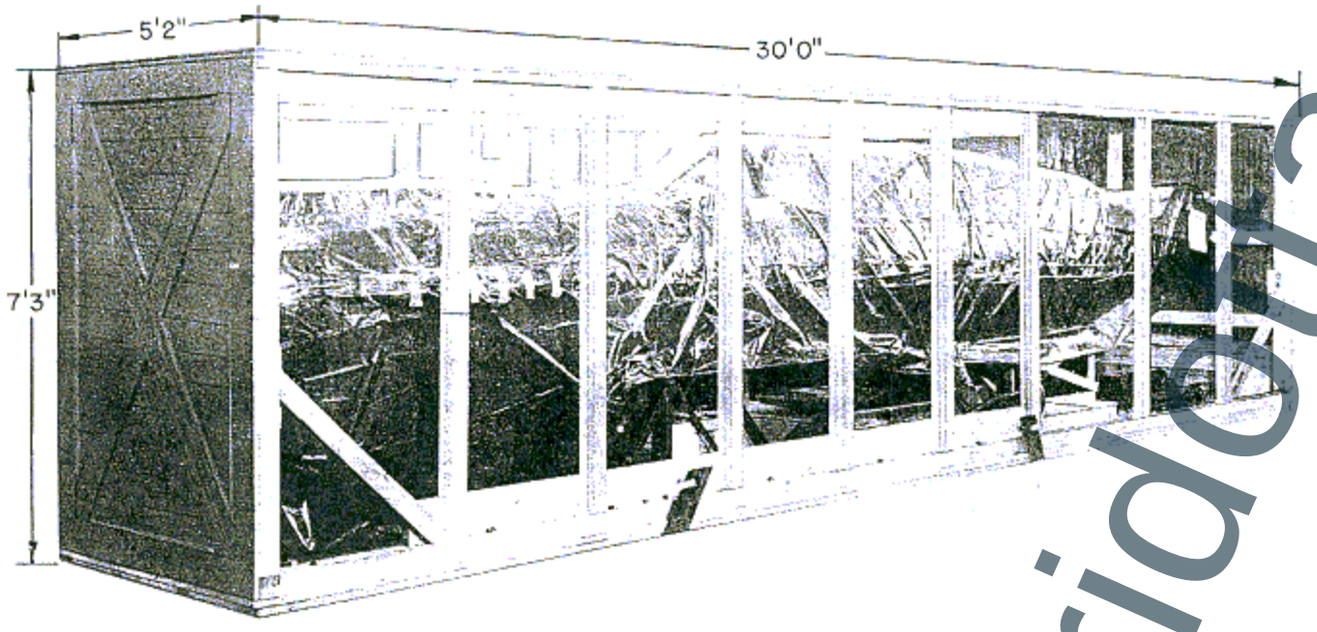
ENGINE

AAF Designation	V-1710-81 (airplanes AF42-104429 thru AF42-106406) V-1710-99 (airplanes AF42-106407 and subsequent)
Gear Ratio (engine to propeller)	2 to 1
Fuel	Specification AN-F-28 Amendment No. 1 100 octane
Oil	Specification AN-VV-O-466
Summer grade	1120
Winter grade	1100

PROPELLER

Manufacturer	Curtiss Propeller Division, Caldwell, New Jersey
Type (three blades)	Electrically controlled Constant speed
Model No.	C532D-F84
Hub Assembly No.	111107-3
Blade No.	89303-24W
Diameter	11 ft 0 in.
Governor Control No.	100,008-1G
Pitch Setting (measured at 42 inch station)	
Low (fine)	24.5°
High (coarse)	54.5°

DEMO dimensione riotta



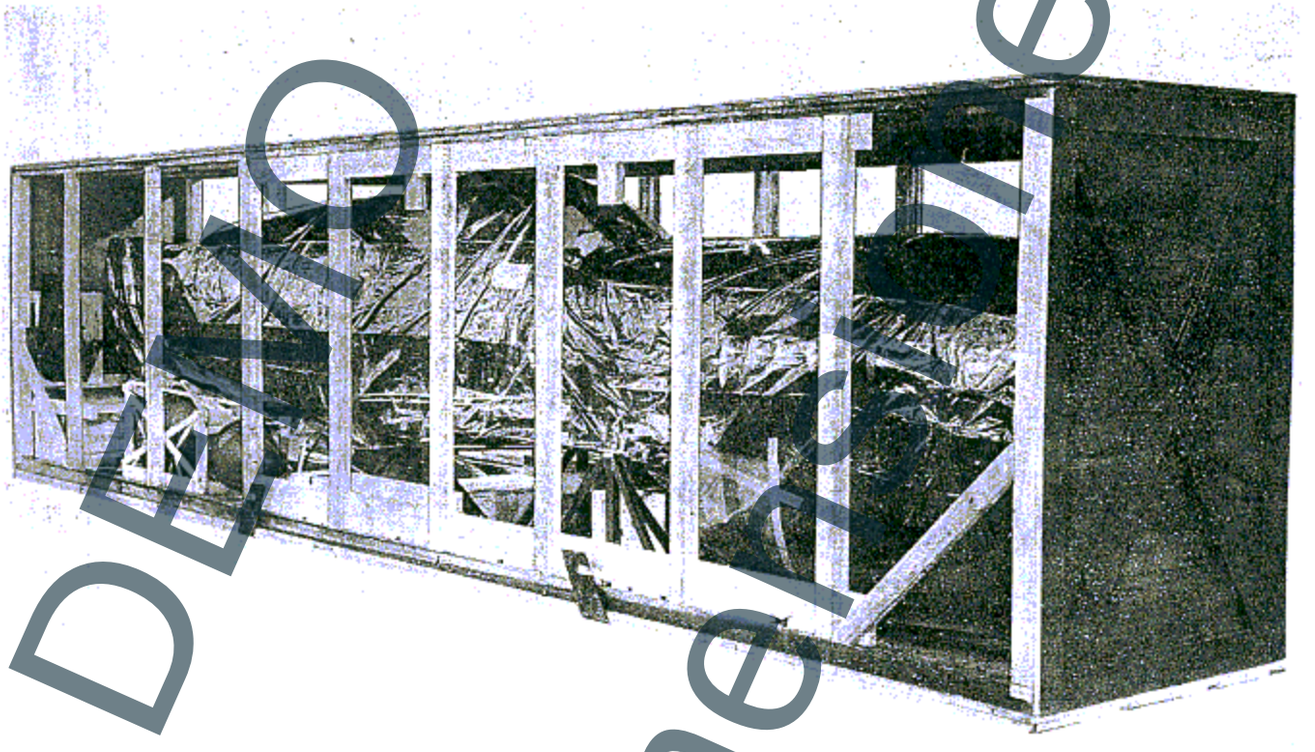


Figure 9—Fuselage Crate—Left and Right Views

DEMO dimensione ridotta

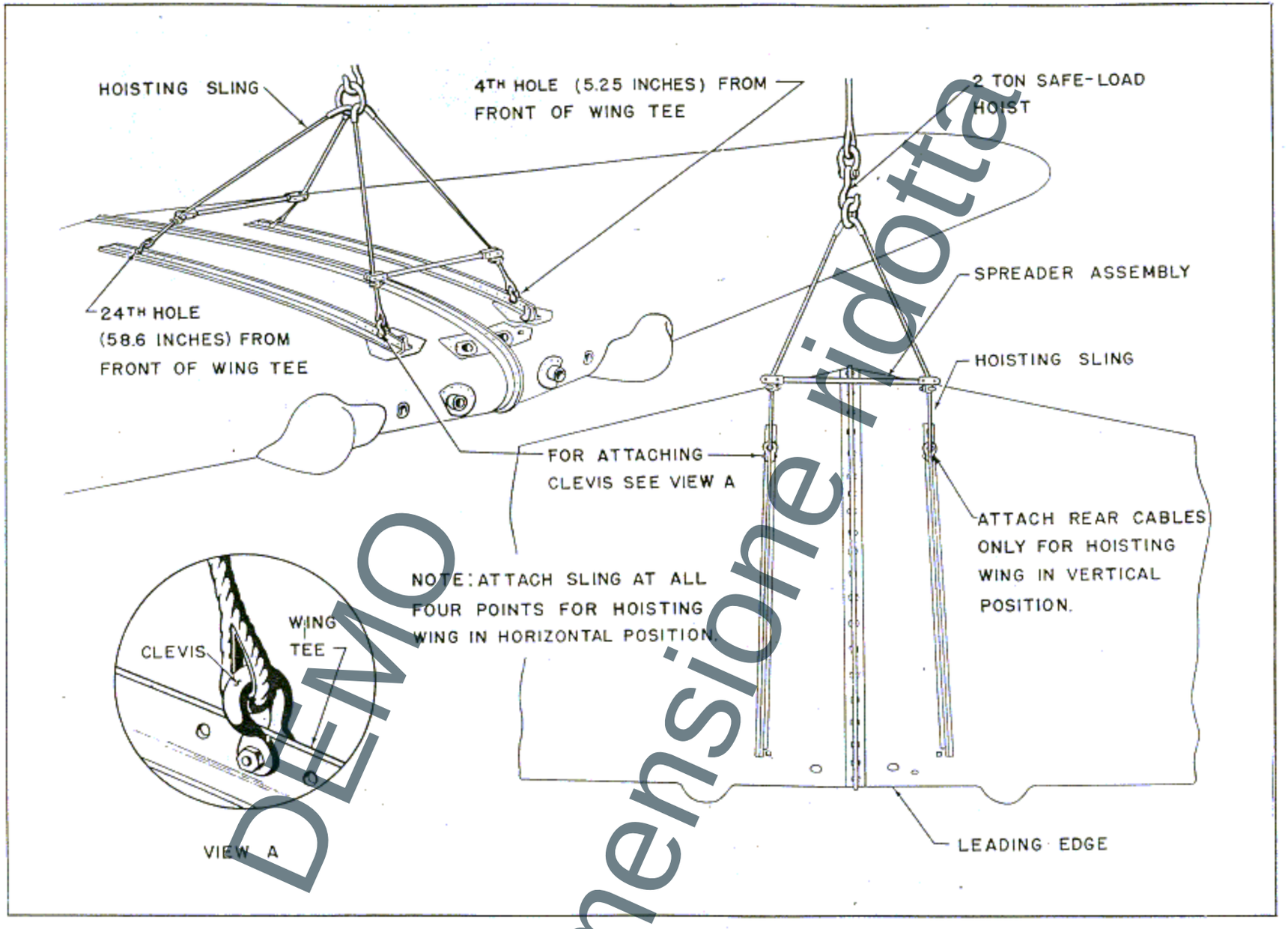


Figure 10—Wing Hoisting

DEMO dimensione ridotta

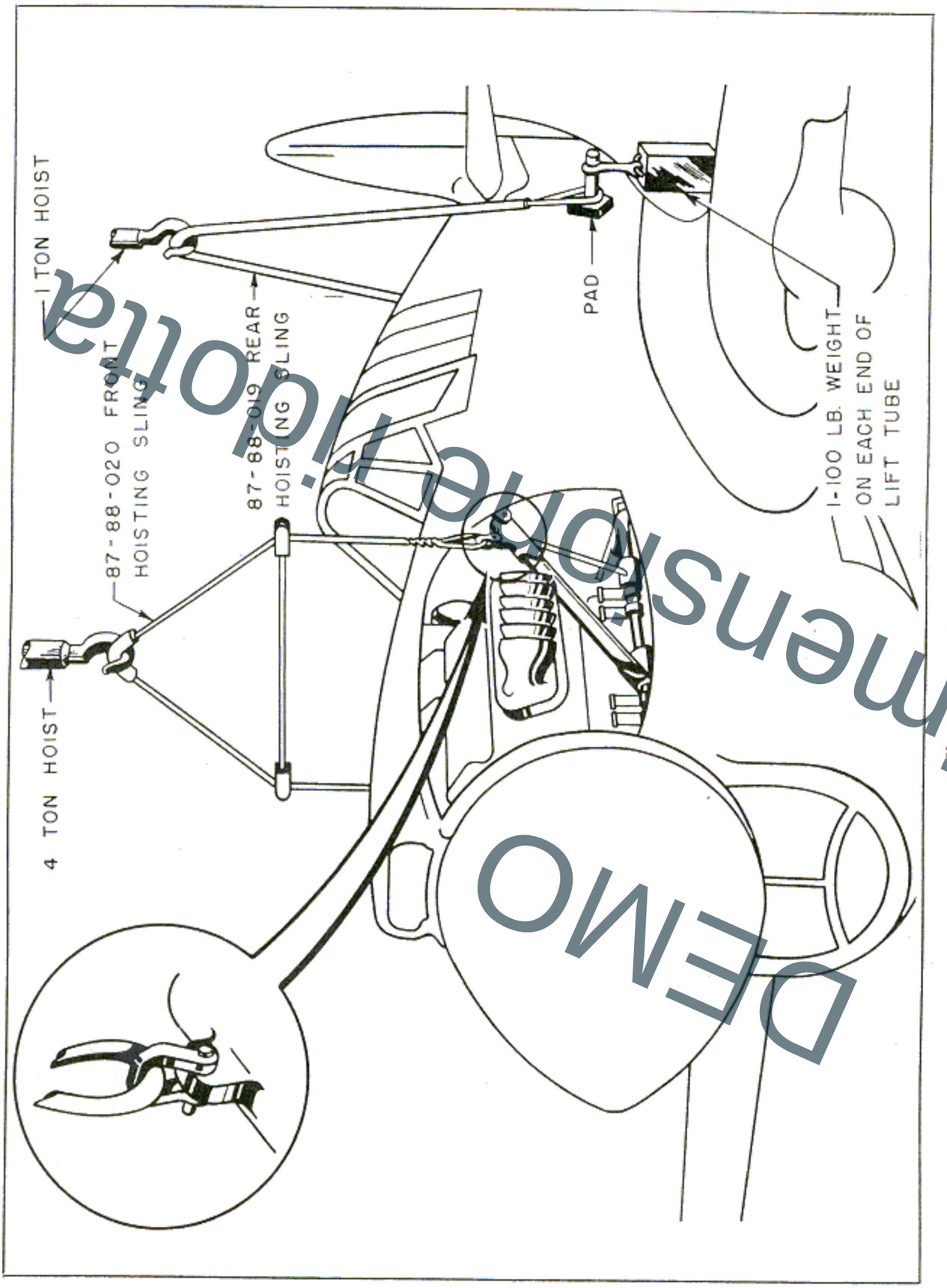


Figure 11—Fuselage Hoisting

DEMO dimensionenmodella

e. FUSELAGE HOISTING.—Remove the side engine cowl from both sides of the fuselage and attach the front hoisting sling to the lugs provided on the engine mount. (See figure 11.) Insert a bar about 3-1/2 feet long through the lift tube at the rear of the fuselage, attach the rear hoisting sling, and hang a 100-pound weight on each side of the bar. Attach the front and rear hoisting slings, each to a hoist, and take up the slack in both sling assemblies. Remove the bolts holding the fuselage to the metal stand, and hoist the fuselage clear of the crate.

Two traveling hoists at least 18 feet high should be available for hoisting the fuselage. The hoist at the forward end of the fuselage should have a capacity of two tons if only the fuselage is to be hoisted, and four tons if the complete airplane is to be hoisted. The hoist at the aft end should have a capacity of one ton.

WARNING

The tail lifting bar must be passed completely through the lift tube in the fuselage and the tail raised by lifting both ends of the bar, otherwise serious strain and damage to the fuselage may occur.
Never use the stabilizer for lifting the aft end of the airplane.
If the tail is raised to flight position, two 100-pound weights should be hung on the lifting bar, one on each side of the fuselage. Do not weight the tail of the airplane by putting sand bags on the fuselage itself.

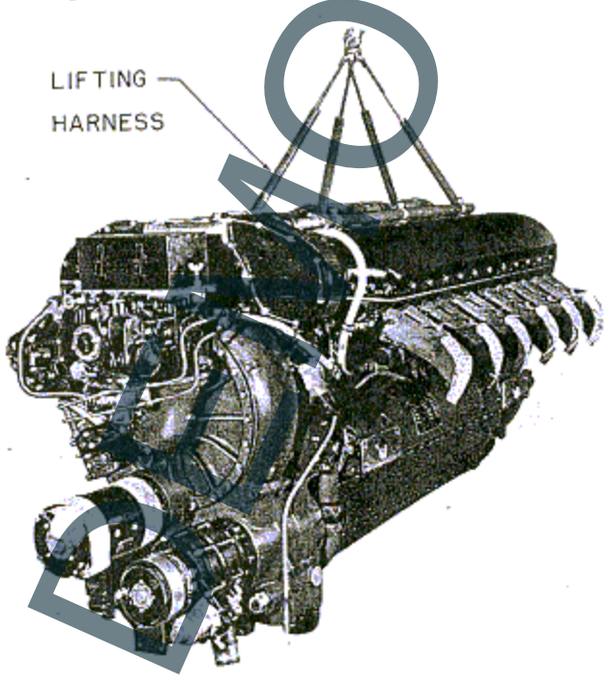


Figure 12—Engine Hoisting

An engine hoisting sling is furnished by the engine manufacturer. By attaching the sling to the studs which hold the cylinder heads to the crankcase, the engine may be raised. (See figure 12.) Do not attempt, under any circumstances, to hoist the airplane by means of the engine hoisting sling attached to the engine. This sling is for the installation and removal of the engine only.

2. ERECTION.

a. When lowering the fuselage onto the wing, exercise great care to avoid damage to contacting parts. Three men are required to insure proper handling.

b. The inside surface of the tee sections on the wing and the corresponding surface of the fuselage should be coated with a light grease before assembly.

c. One man should be placed on top of the wing and the fuselage lowered over him. He should watch the front and the rear to see that the various units in the cockpit are not damaged as the fuselage is lowered onto the wing.

d. Units to be watched carefully are:

(1) ELECTRICAL WIRING.—Make sure that none of the electrical wiring is caught between the tee sections of the wing and fuselage.

(2) HYDRAULIC, FUEL AND OIL LINES.—Watch all hydraulic, fuel, and oil lines to see that they are not pinched or damaged in any way, if the fuselage should swing or sway when it is being lowered onto the wing.

(3) FIREWALL. — The firewall should be watched to see that it does not strike the wing.

(4) OIL "Y" DRAIN COCK.—Do not let the fuselage swing back far enough so that the "Y" drain will strike the wing. If it does, the "Y" drain may be bent or torn loose from its hose connections.

(5) HEATING AND VENTILATING INTAKE DUCTS.—Be careful that the intake ducts are not damaged in any manner while the fuselage is being lowered into position.

(6) MATCH ANGLE.—Be careful of the small part of the match angle which extends beyond the trailing edge of the wing, to insure that it is not damaged in any way.

e. Lower the forward end of the fuselage slightly in advance of the rear, so the front fittings at station 1 may be engaged first. Then align and insert the bolts. Next, lower the fuselage until the remainder of the holes are aligned. Insert a pair of trailing-edge bolts, and the intermediate station (bulkhead) bolts. Insert and tighten evenly the remainder of the bolts. Insert the three bolts attaching the trailing edge of the wing to the fuselage (center).

Note

The nut for the last bolt may be tightened through a hole in the surface of the wing by opening the wing flaps.

Revised dimensionata

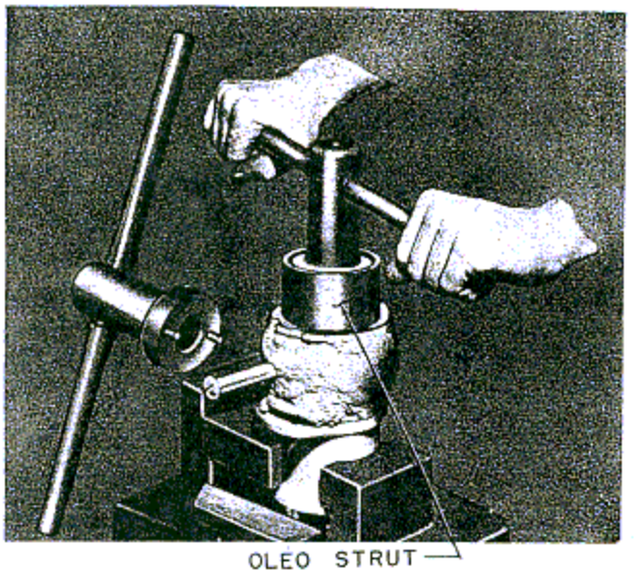


Figure 52—Plunger Assembly Installation Spanner Wrench, P-15765

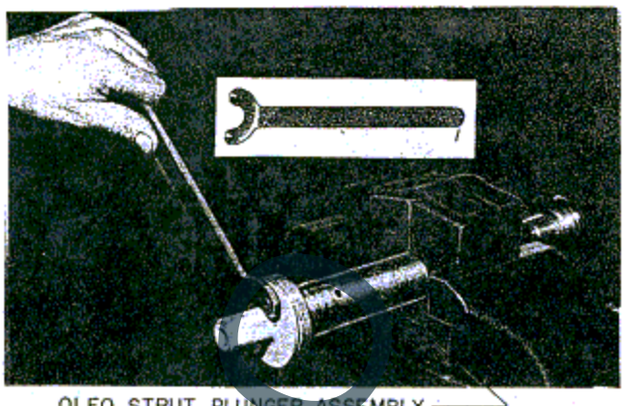


Figure 53—Plunger End Spanner Wrench, P-13171

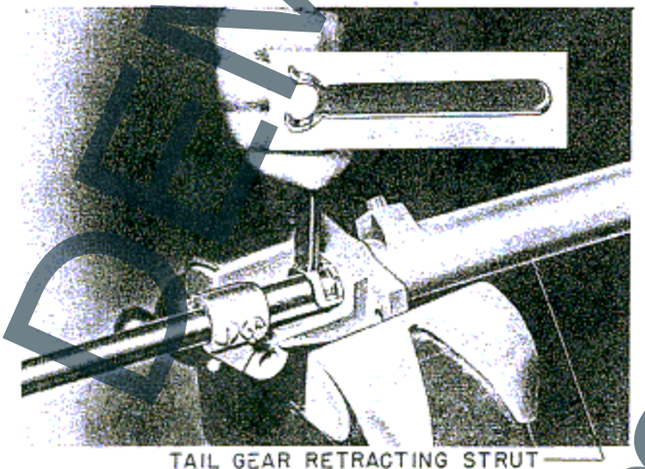


Figure 54—Cylinder Bushing Spanner Wrench, P-10189

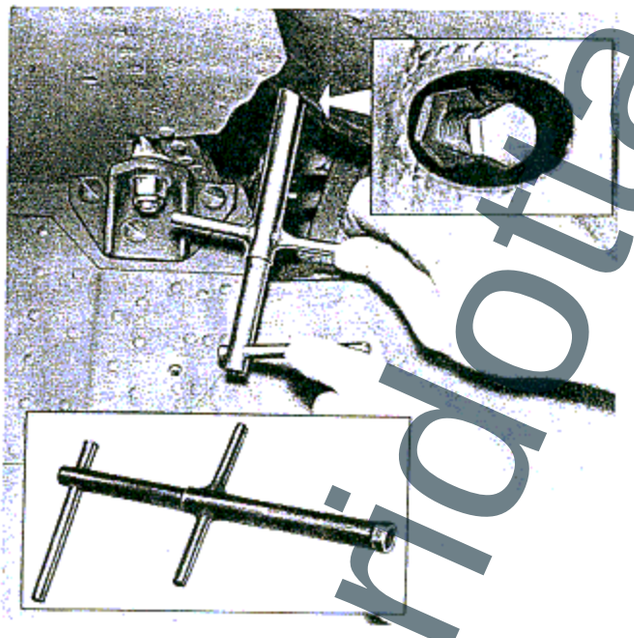


Figure 55—Elevator Trim Tab Control Wrench, P-20233

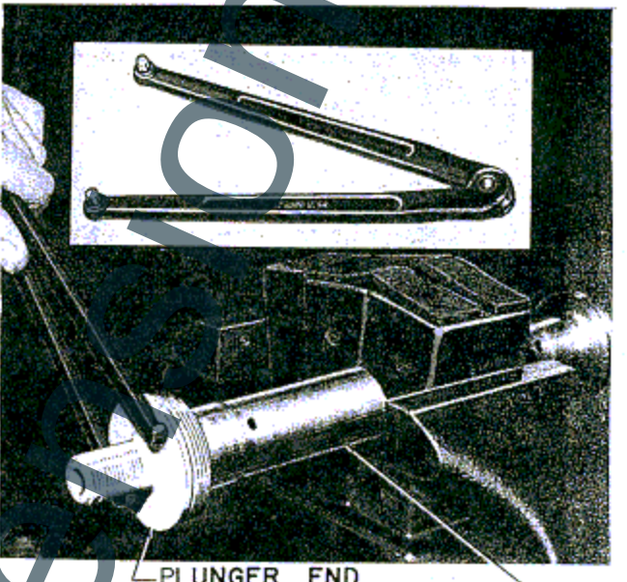


Figure 56—Adjustable Face Spanner Wrench, P-10188

1 PROPELLER SPINNER ASSEMBLY
2 COWLING AND FAIRING
3 ENGINE MOUNT
4 FUSELAGE ASSEMBLY
(AF42-104429 THRU AF42-104828)
5 COCKPIT CANOPY
(AF42-104429 THRU AF42-104828)
6 FIN ASSEMBLY
7 RUDDER ASSEMBLY
8 ELEVATOR ASSEMBLY
9 STABILIZER ASSEMBLY
10 TAIL GEAR ASSEMBLY
11 WING FLAP ASSEMBLY
12 AILERON ASSEMBLY
13 PANEL ASSEMBLY
14 WING TIP ASSEMBLY
15 LANDING GEAR ASSEMBLY
16 COCKPIT CANOPY
(AF42-104829 AND SUBSEQUENT)
17 FUSELAGE ASSEMBLY
(AF42-104829 AND SUBSEQUENT)

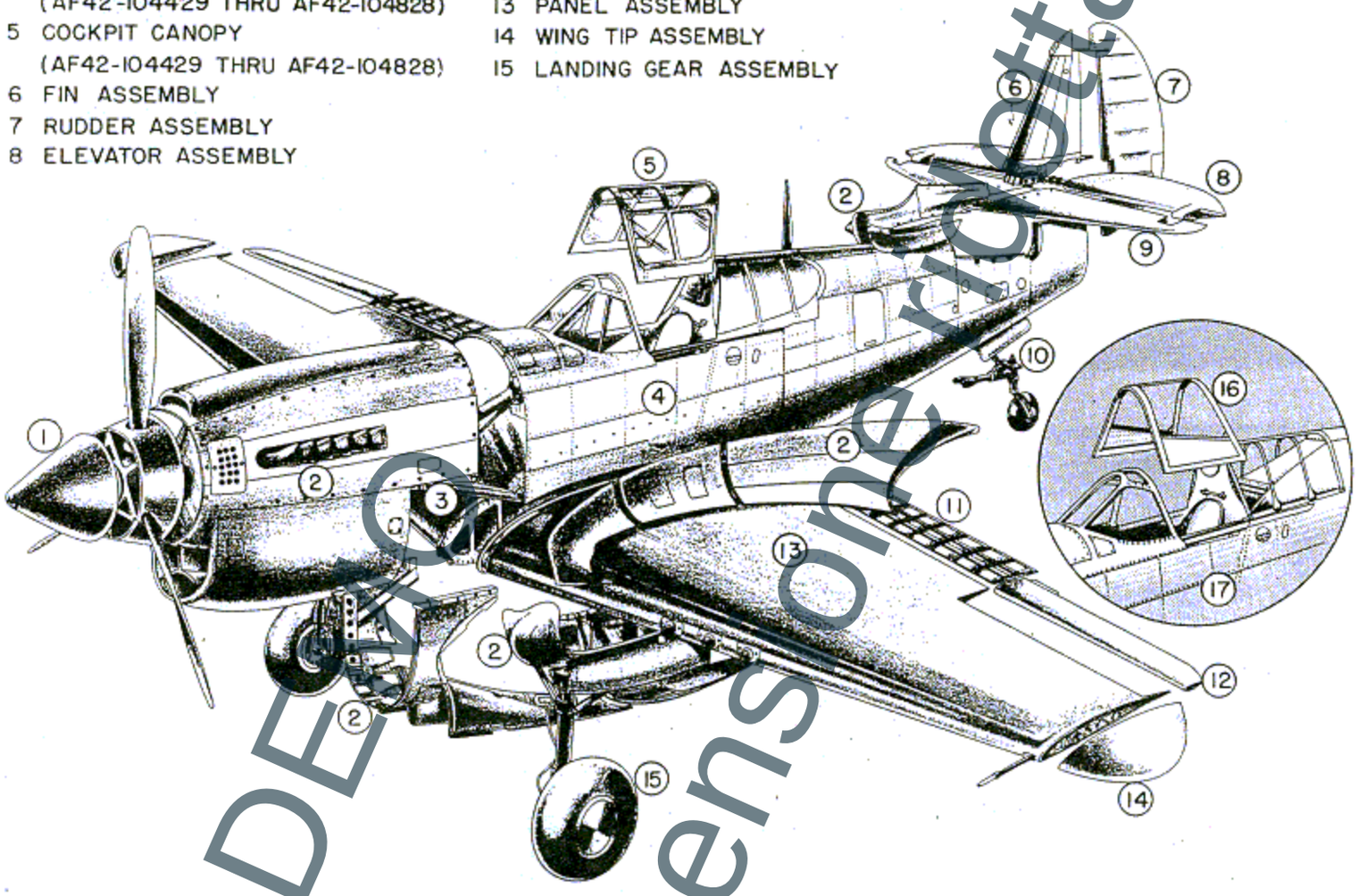


Figure 57—Main Assembly Breakdown

DEMO
dimensionaria data

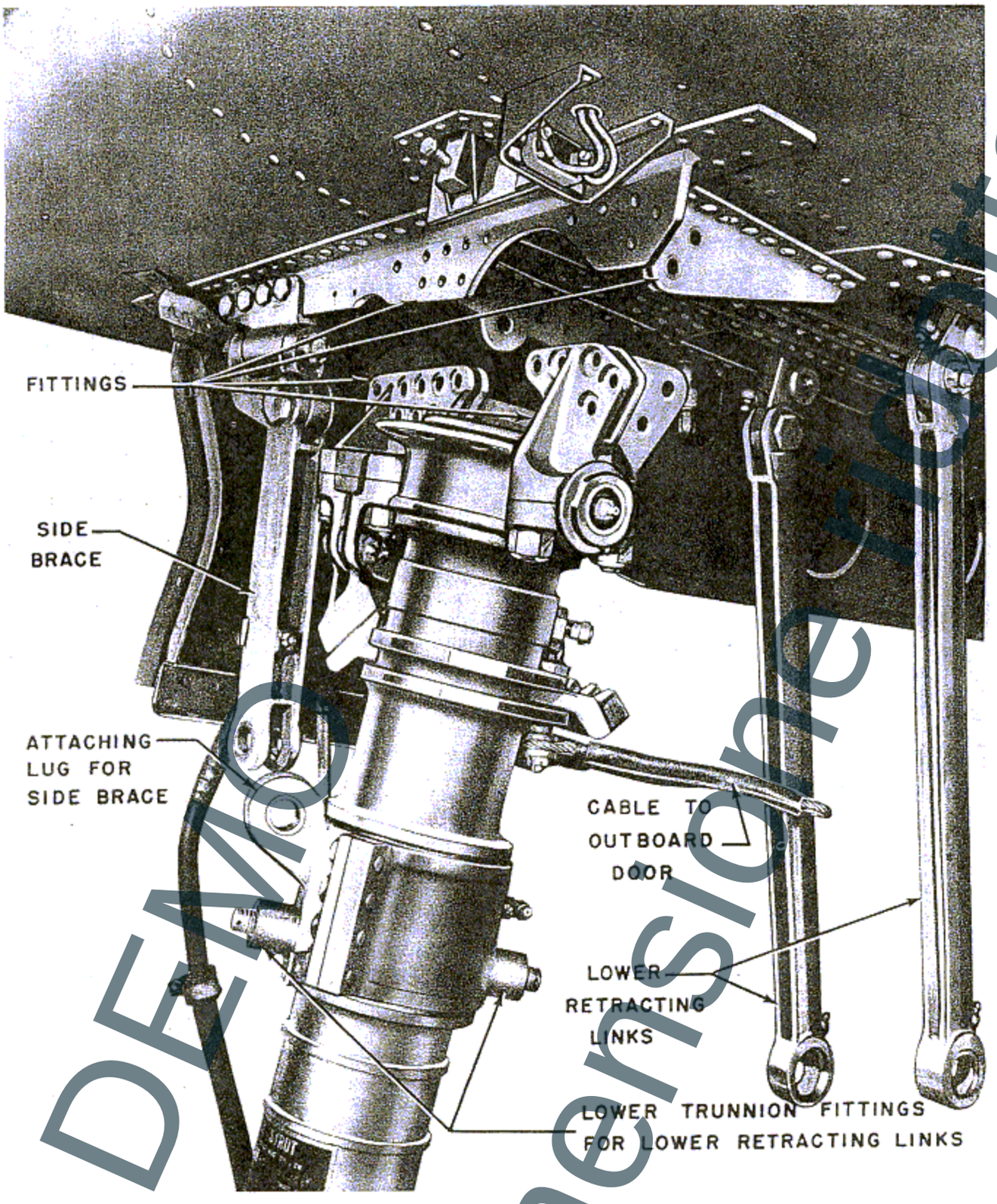


Figure 119—Removing Oleo Strut Assembly from Wing

DEMO dimensione.it

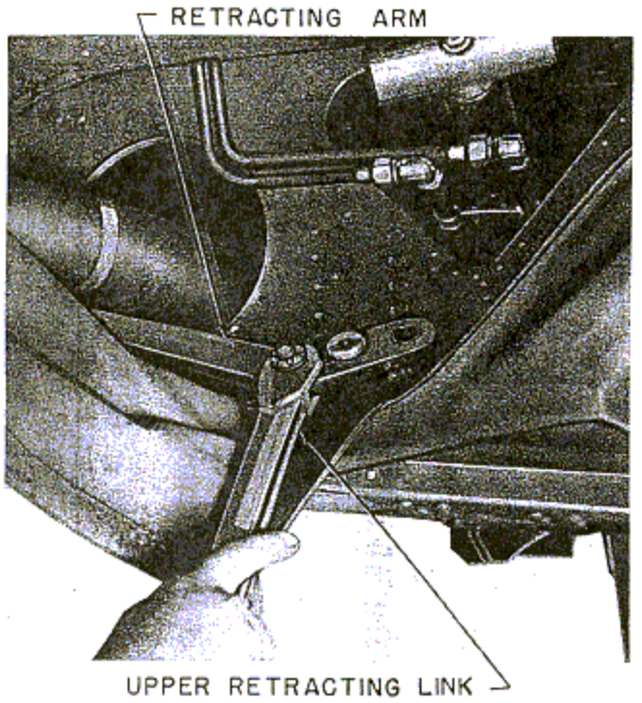


Figure 120—Removing Upper Retracting Links and Retracting Arms

three lock screws on the piston bearing, either by digging the solder out or by applying just enough heat by torch to melt it away. Remove the screws.

14. Use a spanner wrench and turn the piston bearing off the piston. The sleeve, packing ring, packing and gland nut can now be slid off the piston. The piston is now completely disassembled as illustrated in figure 122.

15. If it is desired to remove the plunger from the oleo strut, place the oleo strut in a vertical position in a vise. Mix some asbestos with water until a thick mixture is obtained, and mold a generous ring of asbestos around the oleo as shown in figure 124. This will prevent the heat from the torch, when applied to melt the solder joint, from going down into the oleo cylinder.

16. Apply heat from a torch and melt the solder.

17. Free the oleo cylinder from the vise and turn the cylinder upside down so that the melted solder will run out into a container. Now the plunger can be turned out of the cylinder with a spanner wrench without any flow of solder into the cylinder when the plunger is removed.

18. The oleo strut is now completely disassembled for inspection and servicing.

(c) TO INSPECT THE OLEO STRUT FOR REPLACEMENTS.

1. Before assembling the oleo strut, thoroughly inspect and clean all parts. Any parts found defective in any way should be replaced. Use only alcohol to clean the oleo strut parts.

2. Inspect packings carefully and clean with alcohol. Replace any packing showing the slightest damage.

3. If the plunger has been removed from the cylinder, clean the cylinder top with carbon tetrachloride or equivalent.

(d) TO ASSEMBLE THE OLEO STRUT.

1. Place the cylinder in a vertical position and secure it in a vise.

2. Mold a generous ring of asbestos and water mixture around the cylinder as illustrated in figure 124 to restrict heating to the top of the cylinder.

3. Apply heat from a torch to both the inside and outside of the top of the cylinder. Move the torch around the circumference of the cylinder rapidly so that the metal will not be overheated and consequently lose temper.

4. Have several pieces of tube solder in ring form that will just fit inside the cylinder. Brush the inside of the cylinder around the flange with a soldering solution of 15 percent zinc chloride, 35 percent glycerine, and 50 percent water. Drop a solder ring into the cylinder upon the flange.

5. Place the plunger assembly on a cradle so that it may be rotated, and heat the end of the plunger around the groove above the threads.

6. Brush on soldering solution and apply a generous coating of solder in the groove and on the nut face. Do not solder up the two spanner wrench holes on the nut face.

7. Brush the solder with a clean wire brush and insert the plunger into the cylinder.

8. Tighten the plunger into the cylinder with a spanner wrench.

9. Place a steel rule on the top of the cylinder as in figure 124 to see if the plunger has the proper protrusion above the cylinder. The bottom of the cotter hole in the plunger should be flush with the top of the steel rule. If the protrusion is not sufficient, the plunger must be removed and more solder applied to build up the cylinder flange or another plunger installed. It is imperative that the cotter hole in the plunger comply with the above specified position or it will be impossible to safety the plunger nut when the upper trunnion cap and nut are installed.

10. After the plunger is properly assembled in the cylinder, drop three more rings of solder into the cylinder while applying heat. Drop these rings in one at a time. This should thoroughly seal the joint and build up a solid cap around the plunger face.

DEMO dimensionata

A	87-31-906-5	FITTING
B	87-31-547	CAP
C		SOLDER JOINT
D	87-31-512	PLUNGER
E	87-31-551	BEARING
F	75-31-044	PISTON BEARING
G	75-31-045	SLEEVE
H	AN310-16	NUT
I	87-31-106-6	FITTING

J	87-31-041	UPPER TRUNNION ASSEMBLY
K		FILLING VALVE
L	87-31-525	LOWER TRUNNION ASSEMBLY
M	87-31-916	CYLINDER
N	75-31-050	METERING PIN
O	75-31-048	PACKING RING
P	75-31-049	PACKING
Q	75-31-046	CYLINDER BEARING NUT
R	87-31-912	PISTON

OLEO STRUT ASSEMBLY TO BE TESTED TO A PRESSURE OF 2800 POUNDS PER SQUARE INCH USING HYDRAULIC FLUID AAF SPECIFICATION 3586 UNAMENDED GRADE B (BLUE). CHECK SPECIFICALLY SOLDER JOINT, PACKING AND METERING PIN ON CYLINDER ASSEMBLY.

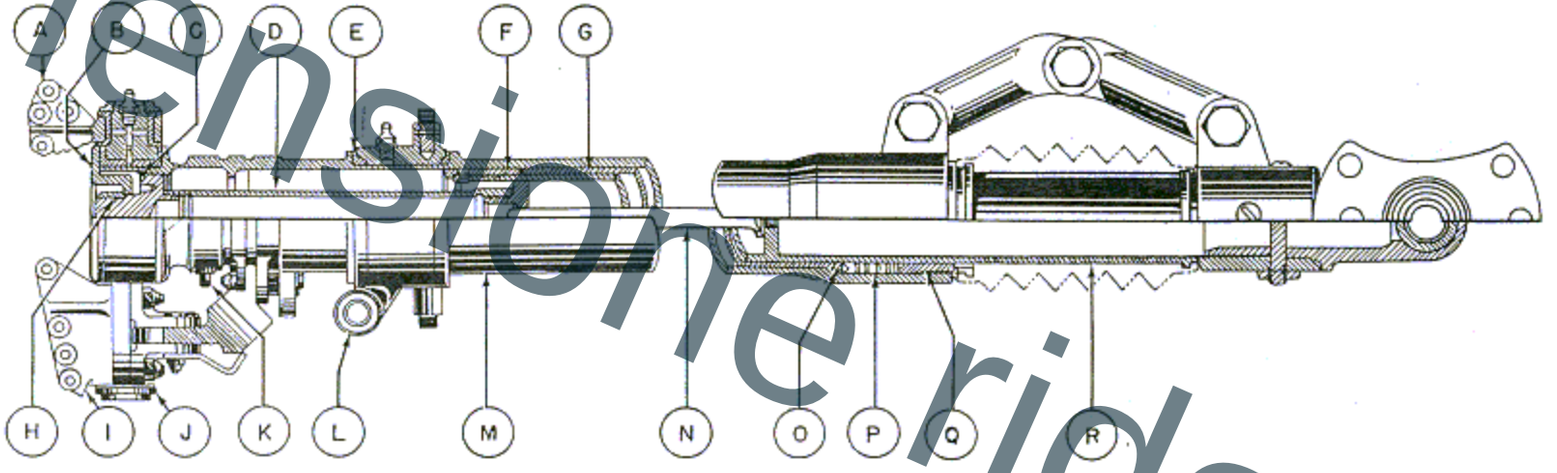


Figure 121—Landing Gear Oleo Strut

DEMO
dimensione ridotta

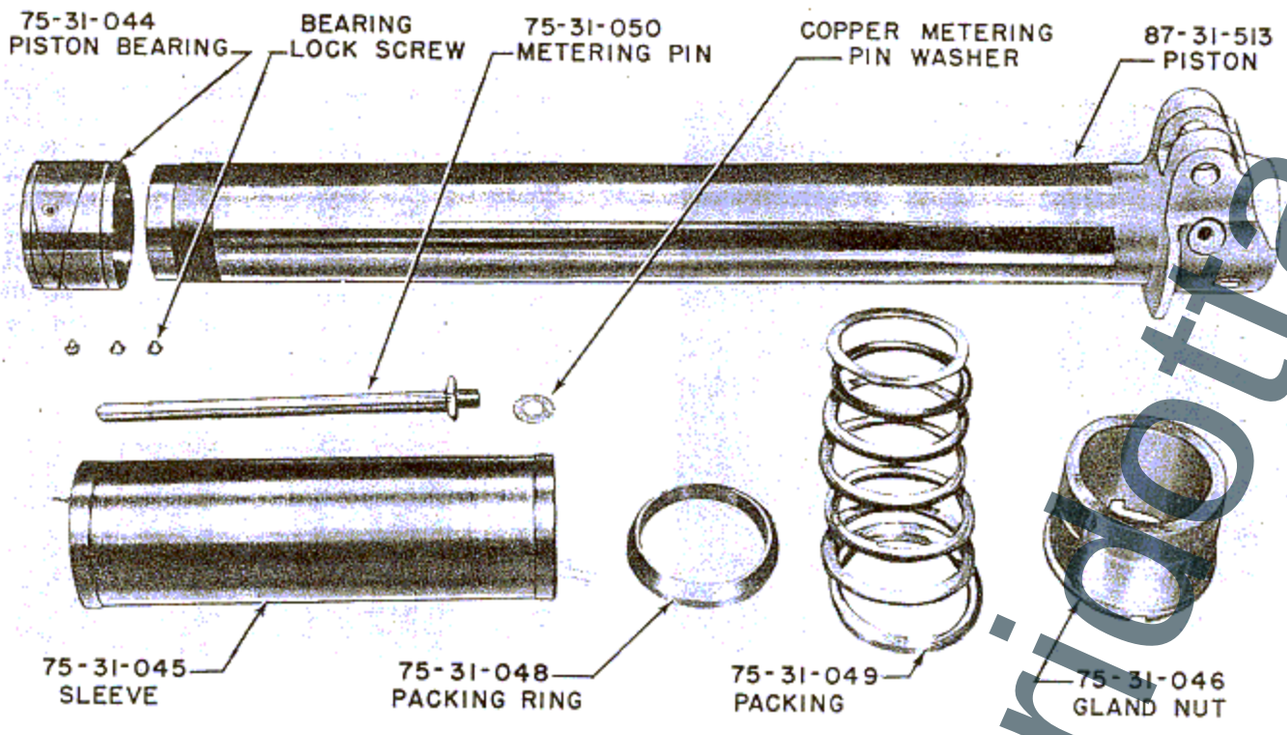


Figure 122—Oleo Strut Piston Disassembled

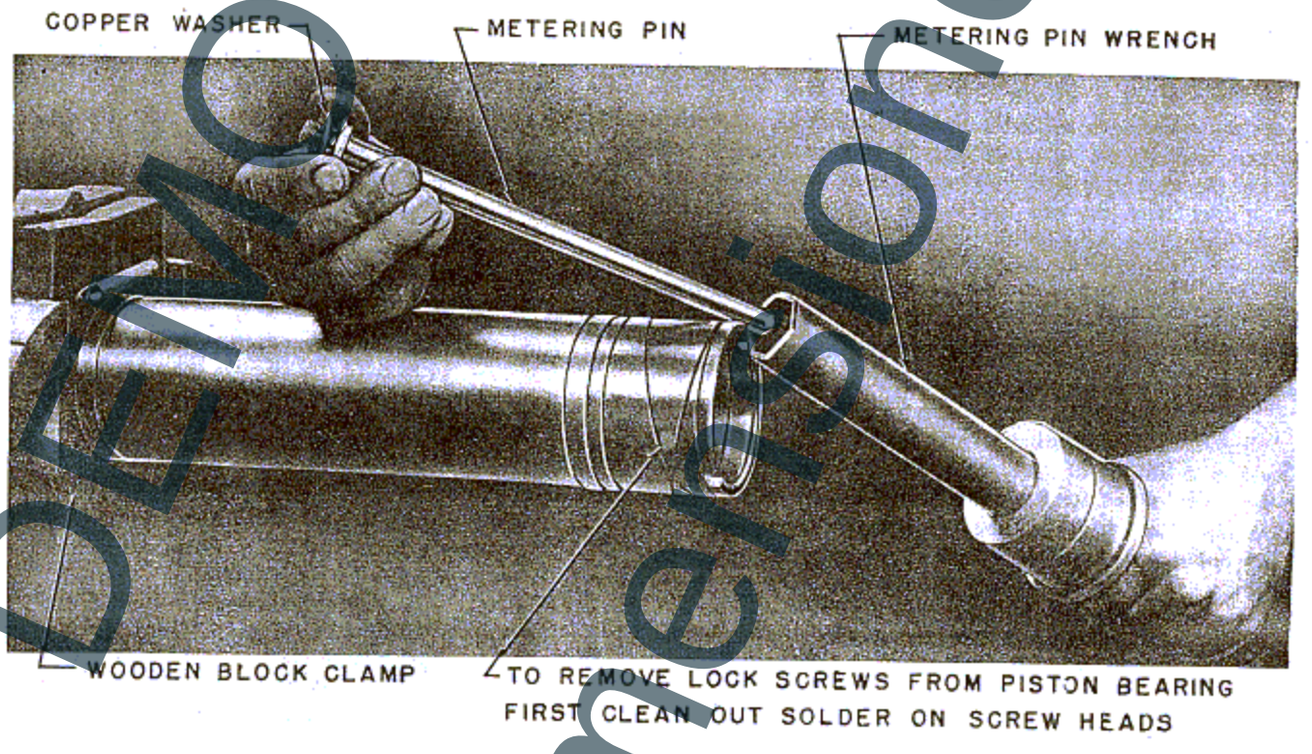


Figure 123—Removing Metering Pin from Piston

DEMO
dimensione ridotta

The throttle lever for the V-1710-81 engine installation, is connected to a main lever on the automatic manifold pressure regulator which in turn is connected to a differential lever that is linked to the carburetor throttle. The throttle lever selects the desired manifold pressure and the regulator maintains this pressure within desirable limits from sea level up to the critical altitude of the supercharger. The control of the propeller governor for obtaining the desired engine rpm for the selected manifold pressure is attained through manual setting of the propeller governor control lever on the engine control quadrant.

The throttle lever for the V-1710-99 engine installation, is connected to a main lever on the automatic engine control unit which in turn is connected to a differential lever that is linked to the carburetor throttle. In addition, the main lever is connected through cams to the propeller governor control lever on the engine control unit. The automatic engine control unit coordinates engine rpm with the desired manifold pressure by the operation of the single lever (throttle lever) on the engine control quadrant in the cockpit. Manual control of the propeller governor is eliminated by the automatic engine control unit. The automatic engine control unit performs the function of the automatic manifold pressure regulator, in maintaining a selected manifold pressure, independent of altitude, up to the ceiling of the supercharger, and coordinates the selected manifold pressure with the proper engine rpm.

A stop is provided in the engine control quadrant which limits the throttle setting to 52 in. Hg. at 3000 rpm. When the seal is broken and the throttle is pushed by the stop to the full forward position, war emergency power of 57 in. Hg. at 3000 rpm is obtained.

The economy manifold pressure modifier lever for the V-1710-99 engine installation provides for increasing the manifold pressure above the selected manifold pressure by approximately 10 in. Hg. without changing the throttle setting (or consequently, the engine rpm). The modifier lever on the engine control quadrant (formerly the propeller governor control lever) is connected to the modifier lever on the automatic engine control unit.

(b) ADJUSTMENT OF ENGINE CONTROLS.

1. GENERAL.—All control rods and bellcranks must be accurately adjusted to give full and free movement of the control levers of each respective unit. The linkage must not be bent or rubbing any part of the airplane through the full movement of the controls from the cockpit control quadrant to the carburetor and propeller governor.

2. ADJUSTMENT OF AUTOMATIC ENGINE CONTROL.

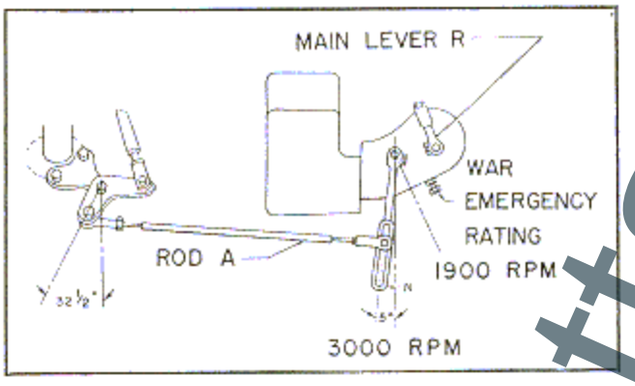


Figure 176—Automatic Control

IMPORTANT

Adjustment of the engine control unit must be accurately made to the dimensions and angles shown in figures 176 and 177.

a. Disconnect rod (A) (figure 176).

b. Move the propeller governor lever clockwise to the 3000 rpm stop.

c. With a protractor measure, make sure that the angles are as shown in figure 176.

d. Place main lever (R) in the extreme counter-clockwise position and check propeller governor control lever (N). As shown in figures 176 and 177, it must be positioned five degrees forward of the vertical center line.

e. If lever (N) is not so positioned change it to the correct position by removing the lever from the splined shaft and replacing it in the next fore or aft splines as found necessary.

Note

The clamp screw at the top of lever (N) must be entirely removed before the lever can be removed from the splined shaft for repositioning.

f. With levers (R) and (N) and the propeller governor lever against its stop they are all in the 3000 rpm position.

g. With the three levers firmly held in these positions reconnect rod (A) as shown in figures 176 and 177.

h. In attaching rod (A) to lever (N), position it as shown in figure 178. The mark on the side of the serrated washer must align with the arrow on the side of the lever (N) as in figure 178.

CAUTION

Each serration of error up or down the slot in lever (N) will result in an increase or decrease of nine rpm in engine operation.

i. If the propeller governor lever does not touch its stop when the main lever (R) is rotated fully counter-clockwise lengthen the rod (A) slightly to obtain the contact with the stop.

j. Check the linkage from the main lever (R) to the quadrant in the cockpit. The movement of

OEM Q dimensionerlotta

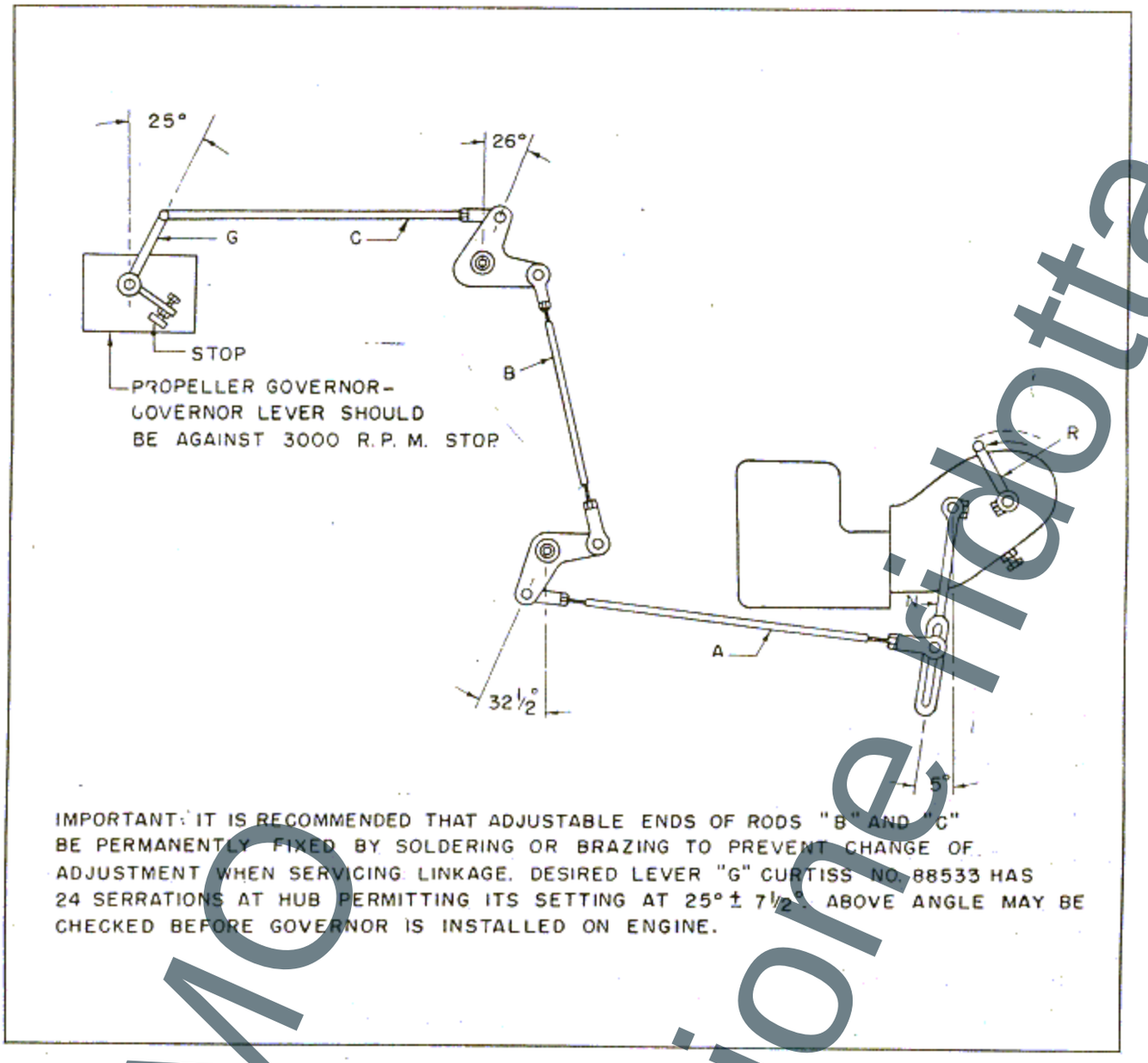


Figure 177—Automatic Control Linkage

the cockpit throttle lever should provide full movement of the main lever (R) with sufficient cushion at both extremes of the cockpit throttle lever movement. When the cockpit throttle is in the closed position, the carburetor butterfly should be fully closed unless it has been set for idling.

3. ADJUSTMENT OF ECONOMY MANIFOLD PRESSURE MODIFIER.

a. The manifold pressure modifier control is to be adjusted by setting the modifier lever on the automatic engine control unit in the "OFF" position against the "OFF" stop (figure 166), and the manifold pressure modifier lever on the cockpit throttle quadrant in the rear position, allowing 3/16 inch cushion.

b. Tighten the set screw on the engine end of the flexible wire and lockwire.

c. Tighten the set screw in the connecting clevis on bellcrank end of the flexible wire control and lockwire.

d. The movement of the cockpit modifier lever from its aft to forward position in the control quadrant should provide full movement of the automatic engine unit modifier lever from its "OFF" stop to the full "ON" stop.

(2) COWL FLAP CONTROL.

(See figure 175.)

(a) DESCRIPTION.—The cowl flaps are manually controlled by the cowl flap control assembly which is mounted on a bracket attached to the right cockpit wall at station 3. The control lever is con-

DEMO dimensione Fiorotta

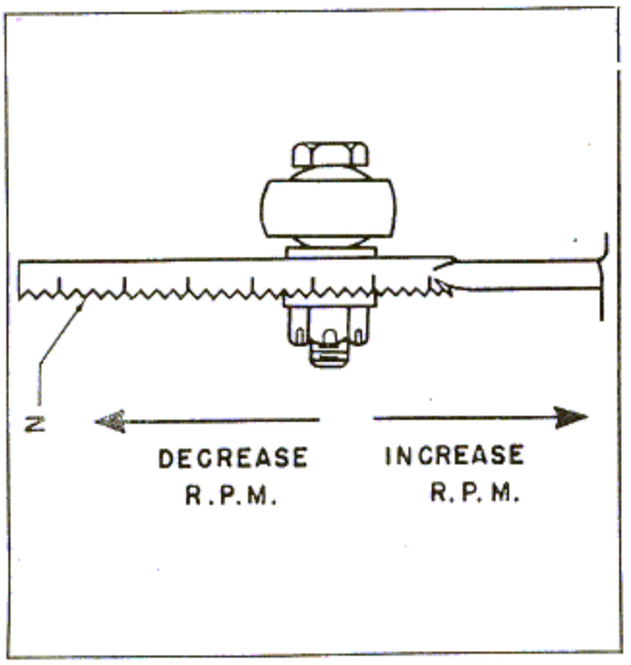


Figure 178—Automatic Control Ratchet

nected by adjustable push-pull rods and bellcranks to a torque which is held by support brackets just forward of the wing leading edge. The cowl flaps, located immediately aft of the forward bottom cowl, are connected by two adjustable links to bellcranks on the torque tube.

The cowl flap control lever may be locked in any selected position by means of a ratchet rack and a finger latch. The finger latch is located near the grip of the control lever. An indicator plate is provided on the control assembly which shows the position at which the control lever should be set for the different operating conditions. The indicator plate is marked: "CLOSED", "HIGH-SPEED", "COMBAT-CLIMB", and "GROUND COOLING". (See figure 29.)

(b) ADJUSTMENT OF COWL FLAP CONTROL.—The control rods, the auxiliary lever assembly and the torque shaft assembly must give full and free movement through the entire arc of its travel.

1. Position the cowl flap control lever so that the finger latch will engage the sixth notch from the aft end of the ratchet rack.

2. Adjust the control rods sufficiently to move the flaps to a contour position with the bottom cowl.

3. Lock and safety all control linkage.

(3) CARBURETOR AIR CONTROL.

(a) DESCRIPTION.—The carburetor air control lever is attached to a bracket on the right upper longeron just aft of fuselage station 3. The single control lever controls the position of three doors in the carburetor air intake duct for admitting either filtered, hot, or cold air to the carburetor. Control of these doors is obtained by a three-way system of push-pull rods and bellcranks connected to the control lever.

The control lever rack has three notches in which the spring-loaded latch of the control lever is engaged to lock the control in either the "FILTERED", "HOT" or "COLD" position. (See figure 28.)

(b) ADJUSTMENT OF CARBURETOR AIR CONTROL.

(See figure 175.)

1. With the air control lever in the filtered or top position in the rack, door (A) must seal in the vertical position and bear tightly against the adjustable stop.

2. Door (A) must seal firmly in the horizontal position when the control lever in the cockpit is in the bottom or cold air position.

3. When the cockpit air control lever is in the center or hot air position, door (A) need not seal tightly.

4. Door (B) must lie flat against stop when the control lever in the cockpit is in either the cold air or filtered air position.

5. Door (B) need not seal when the control lever is in the hot air position.

6. Door (C) must seal firmly when control lever is in either the cold air or the filtered air position.

7. When the adjustments are completed all controls will be locked and safety wired.

d. PROPELLER.

(1) DESCRIPTION.—A Curtiss electric constant speed 11 foot diameter, three-bladed propeller is installed on this airplane.

(2) REMOVAL.—To remove the propeller from the airplane:

(a) Operate the propeller to maximum low pitch.

(b) Remove the right-hand section of the engine cowl and work through the hand holes in the forward engine cowl bulkhead.

Note

The carburetor air filter box installed on the right side of the engine compartment aft of the engine front bulkhead must be removed in order to reach through the handholes in the engine front bulkhead and the spinner aft bulkhead when removing the nose cone. Remove the filter box as follows:
Remove the three screws which hold the filter box to the engine front bulkhead. Loosen the clamps at the hose connection between the filter box and the air intake duct on the top cowl. Lift out filter box complete with hose and clamps.

(c) Disconnect the flexible conduit from the brush holder cap assembly.

(d) Remove the safety pin from the top and bottom brush holder latch assembly.

DEMO
dimensionerotta

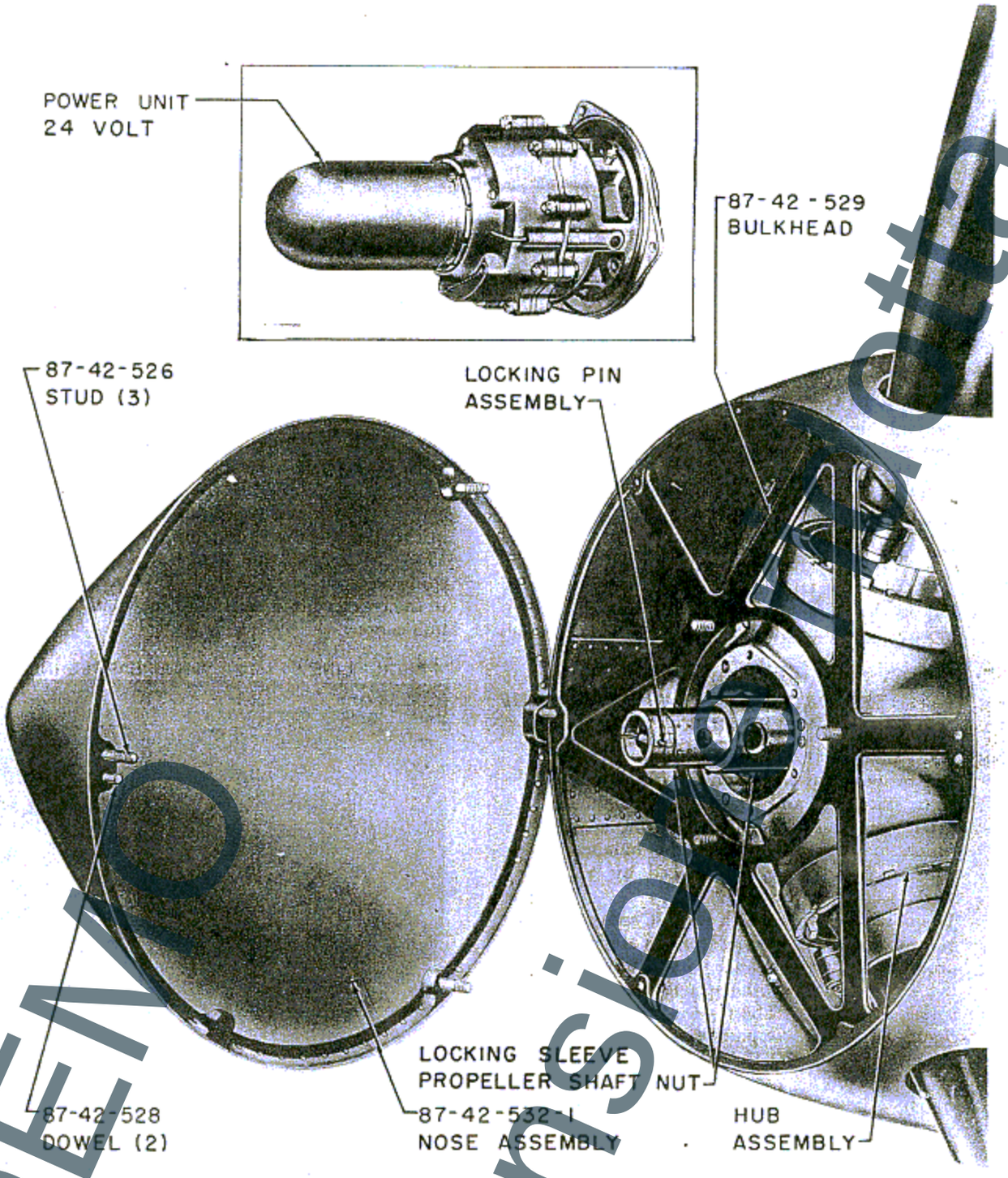


Figure 179—Propeller Assembly—Front View

(e) Raise the brush holder latches and remove the brush holder cap carefully to avoid damage to the brushes.

(f) Remove the three elastic stop nuts attaching the spinner nose cone to the aft section and remove the nose cone.

(g) Remove the cap screws and the three nuts from the flange of the propeller power unit assembly. Remove the power unit assembly, the synthetic rubber seal, and the grease seal from the propeller shaft.

(h) Remove the locking pin assembly and the locking sleeve, install the extension nut with pin, insert a bar completely through the two holes in the nut, and turn the nut off.

DEMO dimensioneta

(i) The propeller may now be removed from the propeller shaft. Exercise extreme care when removing the propeller to avoid damage to the propeller shaft threads. The propeller weighs approximately 375 pounds. Therefore, it is advisable to use at least three men to remove this assembly. Place the propeller in a suitable buck. NEVER allow the end of the blades to support the weight of the propeller.

(3) TO REMOVE THE AFT SECTION OF THE PROPELLER SPINNER FROM THE PROPELLER HUB.

(a) Remove the ten flush-head screws from the three cover assemblies on the outer surface of the spinner aft section and remove the covers.

(b) Remove the outer circle of screws from the rear of the aft bulkhead. DO NOT DISTURB THE INNER CIRCLE OF BALANCE SCREWS.

(c) Remove the aft section of the spinner from the propeller hub.

(4) TO REMOVE THE AFT BULKHEAD FROM THE PROPELLER HUB.—Remove the nine nuts and bolts from the inner flange of the propeller hub and lift the bulkhead from the hub.

(5) TO ASSEMBLE THE AFT BULKHEAD TO THE PROPELLER HUB.—Place the aft bulkhead in position on the aft side of the propeller hub and install the nine bolts attaching the bulkhead to the hub flange.

(6) TO ASSEMBLE THE AFT SECTION OF THE PROPELLER SPINNER TO THE PROPELLER HUB.

CAUTION

The propeller assembly on each airplane has been statically and dynamically balanced. After any damage whatever to a spinner which may have destroyed the balance, it must be rebalanced or replaced by a correctly balanced spinner.

The nose cone, spinner aft section, spinner aft bulkhead, and the three spinner aft section propeller blade covers are each marked with the serial number of the spinner assembly of which it is a part. These parts are not interchangeable with like parts of any other spinner assembly. Each part of the spinner assembly is marked to facilitate correct assembly which will maintain the static and dynamic balance of the complete assembly: A metal marker on the inside of the spinner aft section must align with a similar metal marker on the front of the spinner aft bulkhead upon assembly; the blade covers and the blade openings in the spinner aft section are marked "A", "B", and "C" and the covers must be installed in the blade opening having the same letter as the cover; the nose cone is dowelled and can be installed only one way.

(a) Install the spinner aft section over the hub and propeller blades. Be sure the marker on the spinner aft section is opposite the marker on the spinner aft bulkhead.

(b) Install the outer circle of screws in the rear of the spinner aft bulkhead attaching the spinner aft section to the bulkhead.

(c) Install the three propeller blade covers in the blade openings in the spinner aft section. Be sure each cover is installed in the opening for which it is marked.

(7) TO ASSEMBLE PROPELLER BLADES TO PROPELLER HUB.

(a) When this assembly takes place, make sure that the threads of the hub and blade are clean and free from any metal chips or other foreign matter. (See figure 182.) Coat the thread with a mixture of 70 percent white lead and 30 percent lubricating oil. Remove the locking plates which have been temporarily installed on the nuts of the loose blades. The No. 1 blade is numbered on the retaining nut and this blade must be assembled in the No. 1 hub barrel. The No. 1 blade is opposite the master spline of the hub, and the No. 2 and No. 3 blades are placed clockwise in the hub as facing the front of the unit. (See figure 182.) Each blade has a gear backlash shim. These shims are not interchangeable. Place the blade shim in the correct hub barrel with the chamfer towards the hub center.

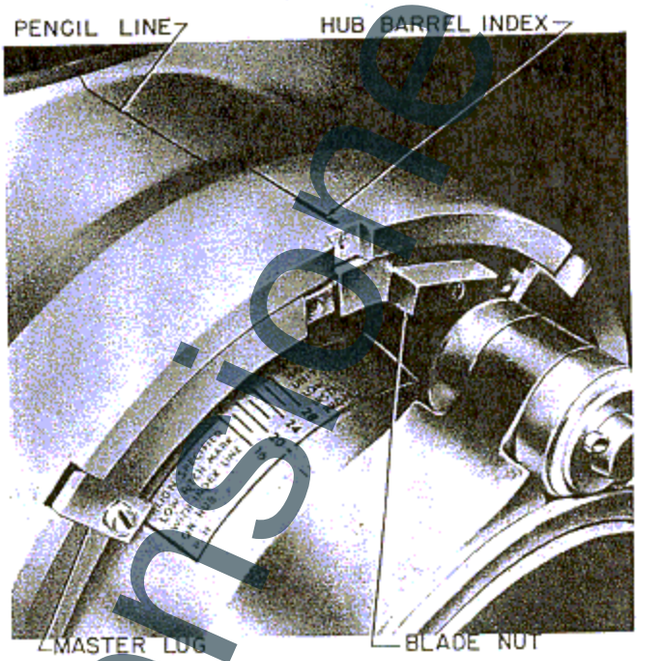


Figure 180—Propeller Hub Indices and Master Lug Slot

(b) MASTER LUG AND BLADE NUT SLOT.—Insert the propeller blade into the hub barrel. Screw each blade nut into the hub until one-half of the threads are engaged. With someone exerting an outward pull on the blade, tighten the blade nut with the spanner wrench provided and approximately

DEMO dimensions

a ten pound brass hammer, until the paint marks on the slots of the blade nut and hub line up. (See figure 180.) If there are no paint marks, tighten the blade nut until it is barely possible to turn the blade by hand. A check should be made with a wooden blade wrench to make sure the blade will rotate after bringing the two slots in line with each other. Insert the lock lug in lined up slots, screw lug into slots securely and lock with lockwire.

Note

The lug which goes into these painted slots is known as the master lug.

(c) HUB BARREL INDICES.—The propeller hub barrels are indexed on the face or front side of hub in order to correctly position the blade sector gear for receiving the power unit. Since the indices on the blade sleeve have proven more or less inaccurate by field personnel, the following method which is now being used, has proven itself simple and sufficiently accurate. Proceed as follows: with the hub and blade assembly on a flat surface, with hub face up, place a straight edge across the face of hub from the hub barrel index to the center of the power unit contact directly opposite on the other side of hub. Draw a straight pencil line along the straight edge from the hub barrel index to the engine shaft opening of the hub. This can be repeated for the second index or hub barrel. When drawing a line for the third index, the line must run between the two power unit contacts which are directly opposite the third barrel. (See figure 180.) After these pencil lines have been drawn, a vertical line is dropped into the engine shaft opening in order to bring the pencil lines close to the teeth of the blade sector gear.

Note

The positioning of the blades is done when the hub and blade assembly is mounted on the engine shaft, otherwise, the setting of the blade sector gears would be disturbed in handling and assembly to engine shaft.

(8) TO ASSEMBLE PROPELLER TO ENGINE SHAFT.

(a) There are two points to make sure of when placing the propeller and hub assembly on engine propeller shaft, namely: make sure that the brushes have been removed from brush housing (remove the two safety pins, unsnap and lift out brush unit) (figure 181) and that the engine propeller shaft has been turned so that the master spline is at the bottom. Have the master spline of the hub at the bottom so that the matching or alignment of these two master splines will be easier to align. (See figure 182.) Clean engine propeller shaft with varnoline and then coat the splines with castor oil. The shaft threads are painted or coated with anti-seize threadlube.

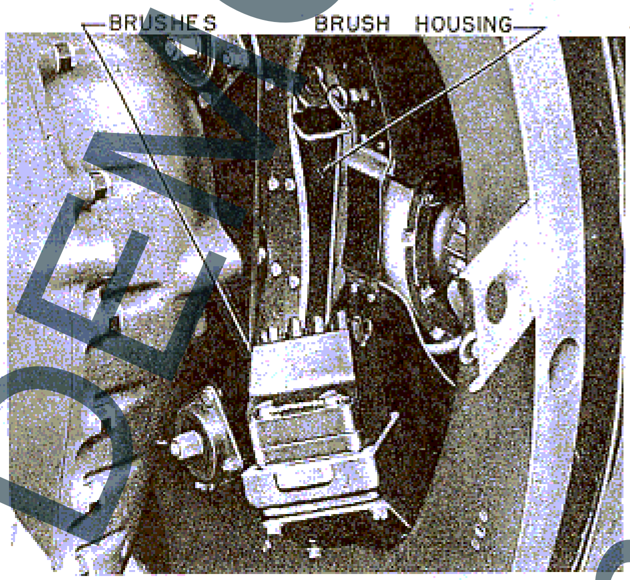


Figure 181—Brushes and Housing

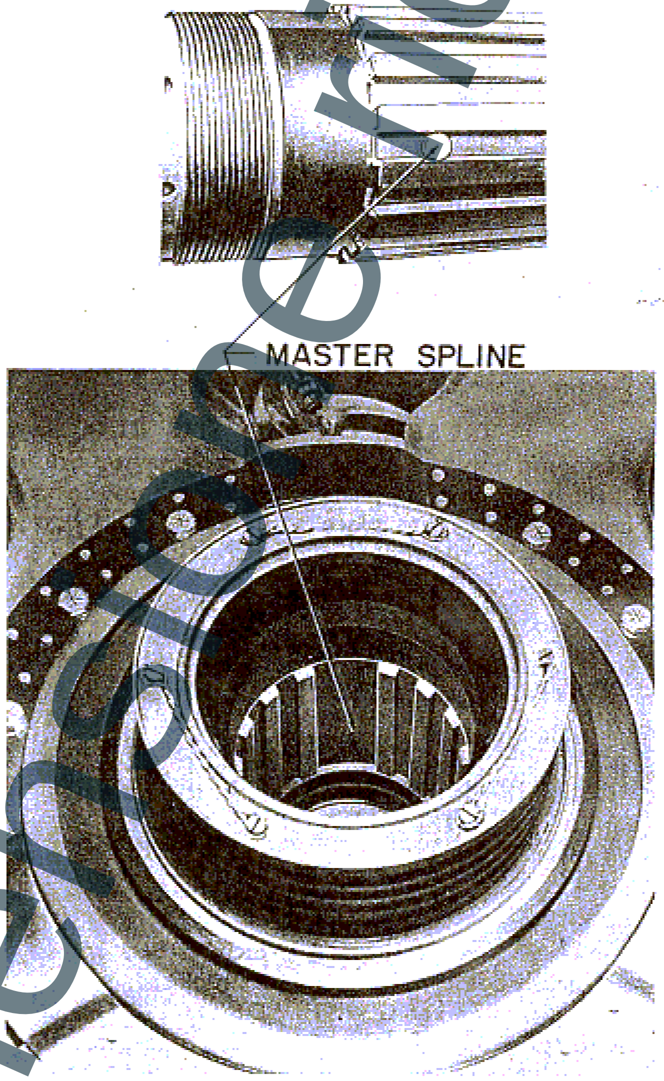


Figure 182—Master Spline

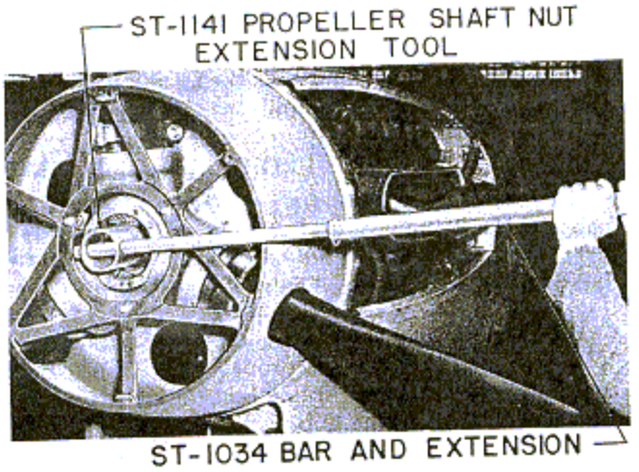


Figure 183—Installing Propeller Shaft Nut

(b) PROPELLER SHAFT NUT.—Just before assembling propeller to engine shaft, install grease seal, split cone, and propeller shaft nut in hub.

Note

The halves of the split cone must be placed over the propeller shaft nut, and the cone and nut are installed as a unit. Place propeller assembly on to propeller shaft and tighten the propeller shaft nut securely with the propeller shaft extension nut provided. Use a round steel bar (approximately four feet long) inserted completely through the two holes of extension nut for this tightening. (See figure 183.) Install propeller shaft locking sleeve and locking pin assembly.

(c) BRUSHES ON HUB SLIP RINGS.—At this point, apply prussian blue to the four top brushes of the brush unit and place brushes back into the brush housing. Snap into place with the top and bottom snaps. Swing the propeller blades backwards and forwards just a trifle, this will show clearly how the brushes are riding on the hub slip rings.

CAUTION

The brushes must not ride the ridges or insulations between the slip rings. If the brushes are not riding the slip rings, shims are provided for installation behind rear cone or brush housing as required. With the brushes correctly positioned, install safety pins into brush housing snaps.

Note

If brushes protrude 3/8 inch or less from brush holder, they should be replaced.

(d) SETTING OF BLADE SECTOR GEAR.—As the propeller blade is rotated into high pitch angle, the leading edge of the third tooth of each blade sector gear is brought up to vertical center line as explained in paragraph (7), *(c)*, preceding. (See figure 184.)

Note

A wooden blade wrench should be used if blades are stiff or difficult to turn.

WARNING

If the blades are not properly set or positioned, the power unit will not mesh into blade sector gears. The above blade positioning is for P-40N series starting with AF42-104429.

(9) TO INSTALL POWER UNIT SEALS AND CONTACT POINTS.

(a) Before assembling power unit to hub, make sure that the felt or grease seal has been dipped in castor oil. This will prevent moisture seeping through the breather holes of power unit housing and severe corrosion inside of power gear. Place felt or grease seal into power gear opening. Place neoprene seal in seal groove of adapter plate just to rear of power gear.

Note

To prevent deterioration, remove and clean this seal each time power unit is removed from hub. Clean the contact points on hub and power unit.

CAUTION

The contact points on the hub must coincide with the contact points in power unit. Place power unit over engine propeller shaft and against the hub. Secure the power unit to the hub with the six attaching bolts and lockwire them together.

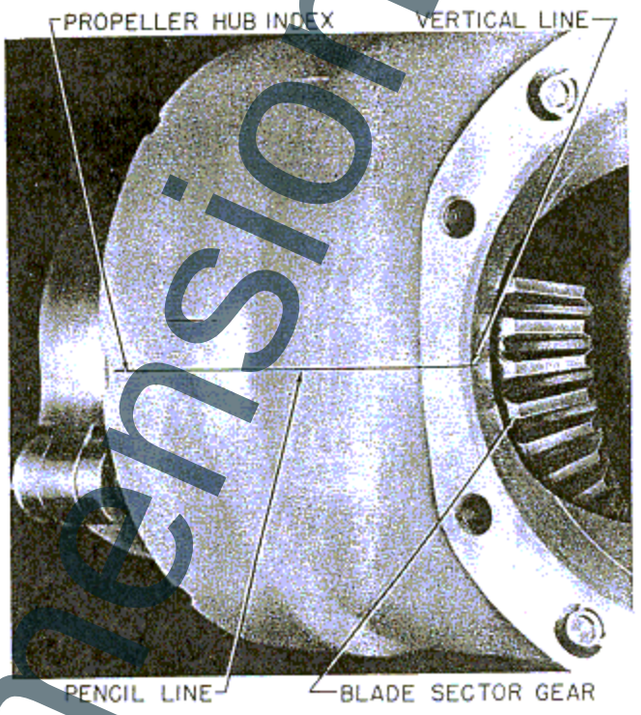


Figure 184—Sector Gears Setting

DEMO dimensione riotta

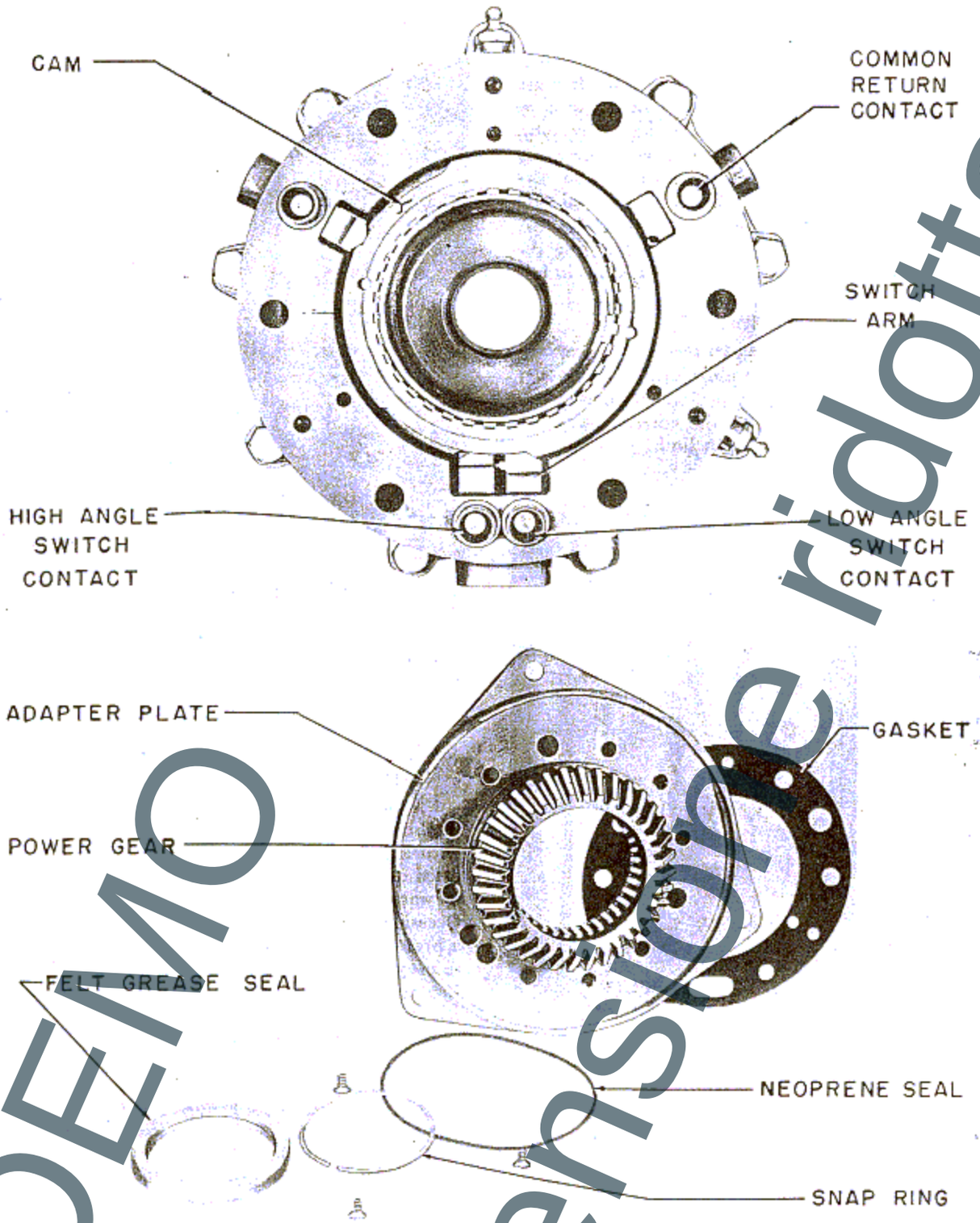


Figure 185—Power Unit Low Pitch Position

DEMO dimensione ridotta

(10) TO ASSEMBLE POWER UNIT — LOW PITCH POSITION.

(a) When placing a power unit in the hub, the power unit must be in low pitch position. If there is any question of this low pitch position, proceed as follows: as facing the power gear of the power unit, remove the three countersunk flat head screws and snap ring with a screwdriver. Remove the adapter plate and its gasket. At this point, the cam and contacts are clearly visible. (See figure 185.)

(b) If the low angle cam is not touching the low angle switch contact, the power unit is not in low pitch position.

CAUTION

Unlock and remove the two mechanical low stop plug bolts and stop plug unit. (See figure 186.) This is done to prevent damage to the speed reducer, should the current carry the cam beyond the stop pin limit.

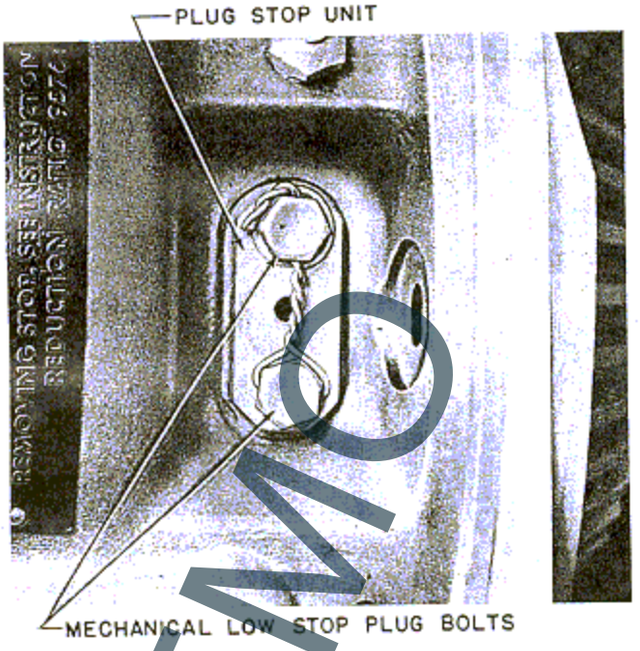


Figure 186—Mechanical Low Stop Plug

(c) Using a 24-volt battery, touch one end of the battery lead to the low angle switch contact. With the other battery lead, make and break contact with the common return contact until the cam just touches the low angle switch contact as illustrated in figure 185. The power unit is now in low pitch position. Replace gasket and adapter plate and fasten with the three countersunk flat head screws. (See figure 185.)

CAUTION

Replace the mechanical low stop plug with the mark "0" (or dot) on stop plug adjacent to mark "0" on housing. Replace stop plug bolts and lockwire together.

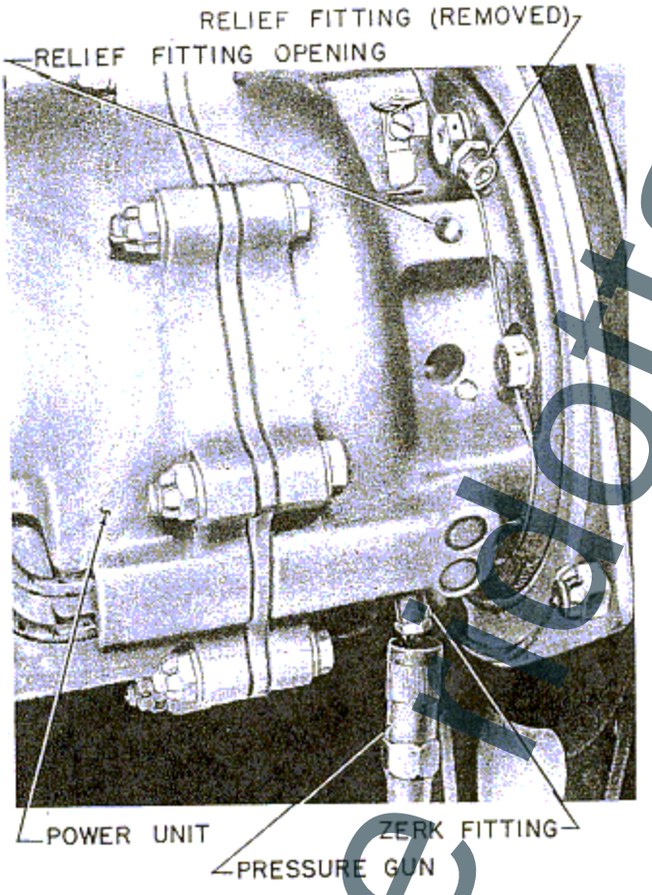


Figure 187—Hub Lubrication

(11) PROPELLER HUB LUBRICATION.

(a) Using the two Zerk fittings alternately, fill the hub with Specification AN-G-4, Grade AA, grease with a pressure gun. These two Zerk fittings are located on the speed reducer (Power Unit) housing just forward of the front hub face. (See figure 187.) Occasionally the grease relief fitting will stick, and as a precautionary measure, the relief fitting is removed to prevent an excessive pressure occurring in the housing resulting in burst seals. (See figure 185.) Fill the hub uniformly, otherwise an air pocket may occur causing the grease to flow out of the relief fitting opening before the hub is completely filled. For airplanes operating in warm climates, it is advisable to use No. 2 grease. Replace relief fitting after hub is completely filled.

(b) POWER UNIT LUBRICATION.—Curtiss speed reducer oil conforming to Specification AN-O-4 is used to lubricate the power unit assembly. This oil level must be checked every 50 hours. Check the oil level as follows: remove the filler plug located near the front of the housing. Rotate the propeller until the plug opening is approximately 20 degrees below the horizontal center line of power unit assembly with the airplane at a ground angle of approximately 12 degrees—or eight degrees below the horizontal center line when the airplane is levelled (tail up). In either

DEMO dimensione data

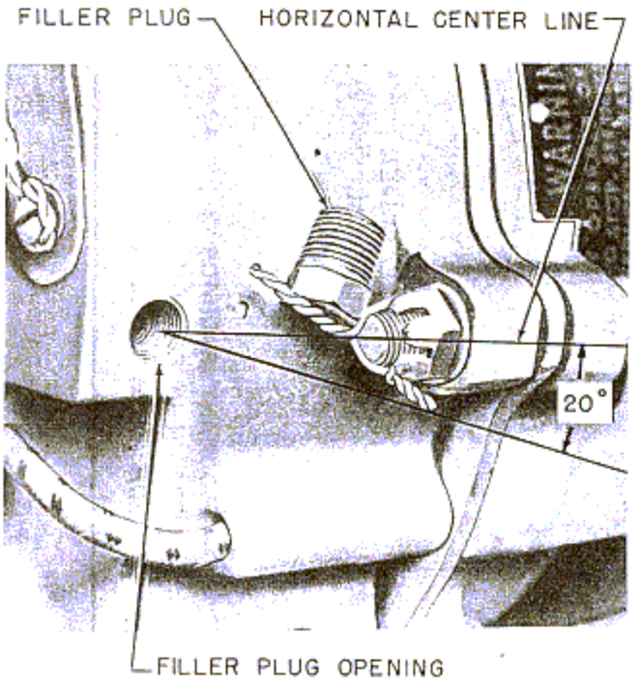


Figure 188—Power Unit Lubrication

of these positions, the oil in the speed reducer should be visible at the plug opening, if not, fill at this plug opening until proper oil level is reached. Replace filler plug and lockwire.

e. STARTING SYSTEM.

(1) Engines in airplanes AF42-104429 through AF42-105639 are equipped with a type B-9 hand inertia starter. When the starter has been energized, the hand crank must be removed before actuating the starter engaging mechanism. Applicable instructions for starting engines equipped with the B-9 starter are given in section III, paragraph 3, *a,* (2).

(2) Engines in airplanes AF42-105640 and subsequent, are equipped with a type G-6, 24-volt combination electric inertia, direct cranking starter. See section IV, paragraph 7, *d,* (8).

f. COOLING SYSTEM.

(1) GENERAL DESCRIPTION. *(See figure 189.)*—The engine is liquid cooled, using ethylene glycol, Specification AN-E-2, as the coolant liquid. A centrifugal coolant pump located on the bottom of the accessories housing supplies coolant to each cylinder block at two inlets, one located at the coolant jacket and the other at the rear of the cylinder head. The outlet scroll of the pump terminates in a tee with two flanged ends, and is connected by pipe to the dual inlets of each cylinder block. The coolant is admitted to the bottom of the cylinder block through an inlet manifold which is cast the full length of each jacket. These manifolds have an orifice at each cylinder barrel which meters the coolant flow. The inlet at the rear of the cylinder head provides a direct rapid flow over the combustion chambers. The coolant leaves the engine through the outlet in front of the cylinder head and is conveyed through pipes to the coolant radiators where the heat is dissipated before it is returned to the coolant pump and recirculated through the engine. A coolant expansion tank mounted at the highest position on the firewall provides a head and insures a constant supply of coolant liquid to the pump.

(2) COOLANT EXPANSION TANK.

(a) DESCRIPTION. *(See figure 190.)*

1. The coolant expansion tank is attached by a strap and bracket assembly to the forward top center part of the firewall. It has a total capacity of 3.5 US (2.9 Imperial) gallons. The filler cap is on top of the expansion tank and is accessible through an access door in the top engine cowl. The top forward part of each cylinder block is vented directly to the expansion tank. The overboard vent line extends from the filler assembly on the top of the tank through the tank to the right side and out through the right side engine cowl.

2. In airplanes AF42-104429 through AF42-104828, a spring-loaded pressure relief valve is incorporated in the filler cap. This valve opens when the pressure in the cooling system exceeds the atmospheric pressure by 15 pounds per square inch. Excess pressure is vented through the overboard vent line. A small vacuum relief valve is provided in the filler assembly and opens when the atmospheric pressure exceeds the pressure in the system. (See detail A, figure 190.)

3. In airplanes AF42-104829 and subsequent, an altitude compensated pressure relief valve is incorporated in the filler cap. Altitude compensation is accomplished by means of a sealed bellows which is highly evacuated. Atmospheric air pressure tends to collapse the bellows which in turn decreases the effective spring force that seats the valve.

In the normal spring-loaded valve described in paragraph 2, preceding, a decrease in atmospheric pressure allows the cooling system relief valve to open at a lower absolute pressure. However, in the case of this altitude compensating relief valve, the decreasing atmospheric pressure relieves the collapsing pressure on the sealed bellows, hence the internal spring is able to provide more force to seat the valve. The increasing force being directly proportional to the decreasing atmospheric pressure will maintain a constant absolute cooling system pressure, fulfilling the function of this valve. This valve opens at 23 pounds per square inch absolute pressure. Absolute pressure is equal to gage pressure (pressure in cooling system) plus atmospheric pressure. Example: At sea level, with standard atmospheric pressure of 14.7 pounds per square inch, this valve should open when the pressure in the cooling system reaches 8.3 pounds per square inch gage. Excess pressure is vented through the overboard vent line. A small vacuum valve also in the filler cap connects the vent passage directly to the tank and opens when the

DTIC
dimensionata

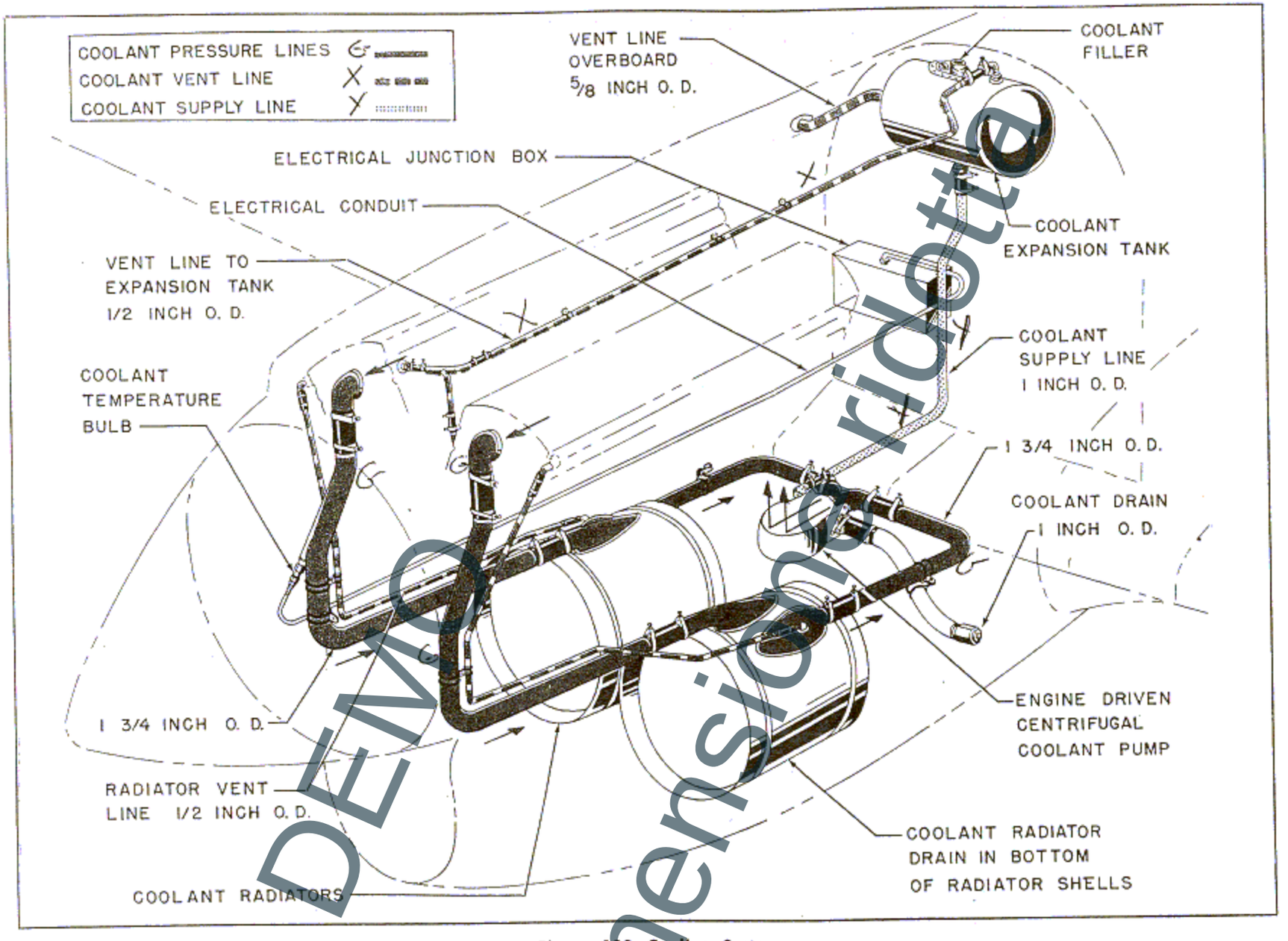


Figure 189—Cooling System

DEMO dimensionsriotta

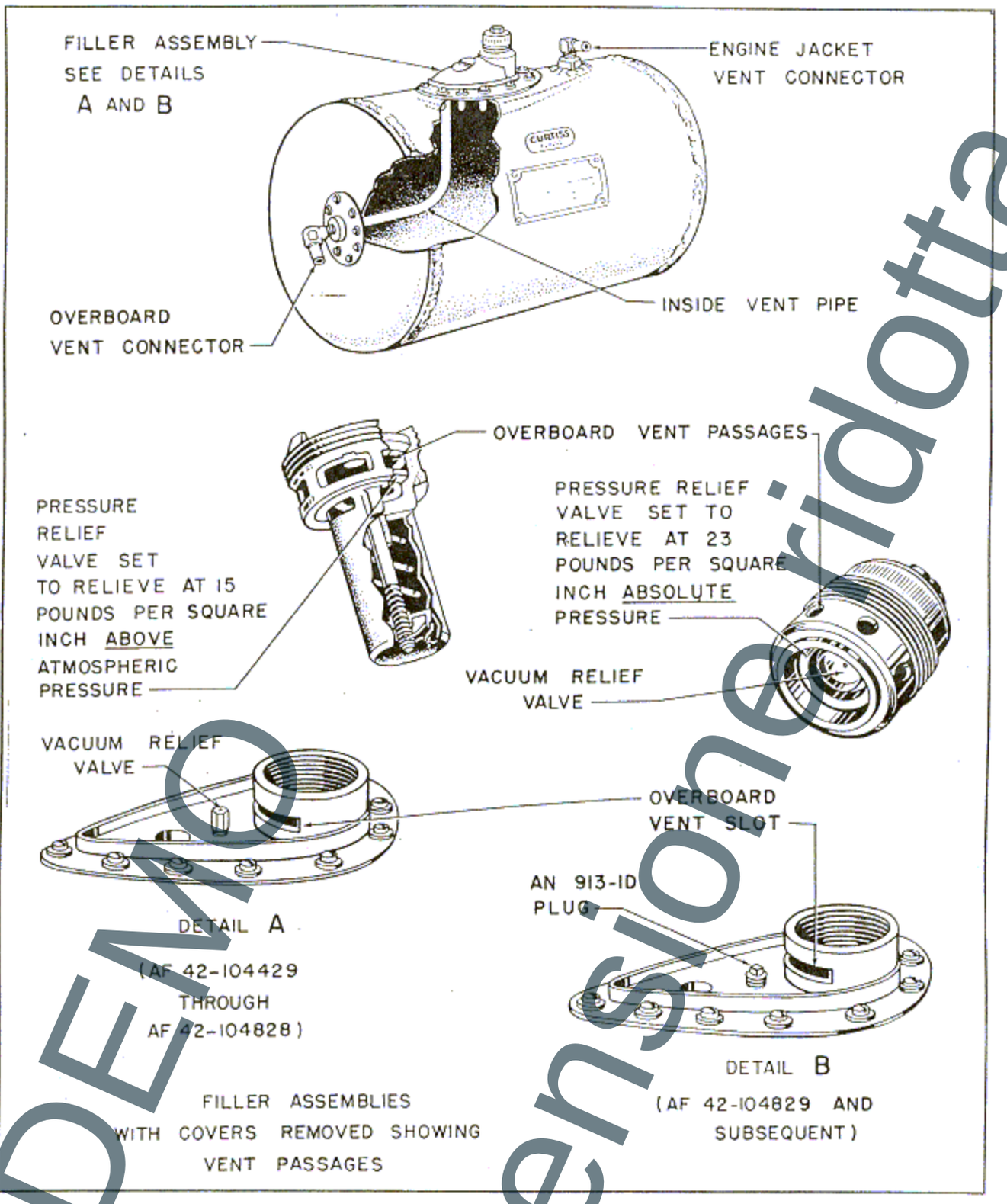


Figure 190—Coolant Expansion Tank Details

DEMO dimensioni ridotta

atmospheric pressure exceeds the tank pressure by one pound per square inch gage or less. (See detail B, figure 190.)

(b) REMOVAL OF COOLANT EXPANSION TANK.

1. Remove the top and side engine cowls. Remove the skin from the left rear side cowl in order to gain access to the coolant pump drain line.

2. Drain the coolant system at the plug on the end of the coolant pump drain line. (See figure 170.) The filler cap on top of the coolant expansion tank should be removed to speed drainage, and the airplane in its normal three-point ground position.

3. Disconnect the coolant vent line at the top of the expansion tank.

4. Disconnect the overboard vent line at the right end of the expansion tank.

5. Disconnect the coolant supply line from the tank fitting under the expansion tank.

6. Disconnect the two top connections of the strap assembly holding the expansion tank to the firewall, and remove the tank.

(c) REPAIR OF COOLANT EXPANSION TANK.—The coolant expansion tank may be repaired by employing the same precautions in cleaning and using the same methods for repair as outlined for the oil tank in section IV, paragraph 6, *g*. After the tank is repaired, test the tank under water with 20 pounds per square inch air pressure.

(d) INSTALLATION OF COOLANT EXPANSION TANK.

1. Reinstall the coolant expansion tank by replacing it in the strap assembly that supports the tank on the firewall.

2. Connect the coolant supply line at the hose connection under the expansion tank.

3. Connect the overboard vent line at the hose connection on the right side of the tank.

4. Connect the coolant vent line at the hose connection at the top of the tank.

5. Replace the drain plug in the end of the coolant pump drain. Tighten the plug and safety wire.

6. Replace the top and side engine cowl. Replace the skin of the left rear side cowl.

(3) COOLANT PUMP.—The coolant pump is a centrifugal type mounted on the bottom of the engine accessory housing and driven by the accessory gear train. The coolant pump drain pipe and plug are attached to the left side of the coolant pump body. The drain plug is safety wired to the drain pipe. (See figure 170.)

(4) COOLANT RADIATORS.

(a) DESCRIPTION.—Two coolant radiators, contained in a support and strap assembly, are hung on four shock absorbing mounting brackets which are installed on the engine mount. The coolant radiators are equipped with either aluminum alloy or copper tube cores. The radiators are vented to the front of each cylinder block to avoid air locks in the radiators.

(b) REMOVAL OF COOLANT RADIATORS.—The oil cooler and coolant radiators may be removed from the airplane as one complete assembly, or each unit may be removed separately.

1. TO REMOVE ONE RADIATOR.

a. Remove the side and forward bottom engine cowls. See section IV, paragraph 5, *b*.

b. Drain the coolant system through the two drain plugs, one in the bottom of each coolant radiator.

c. Remove the safety pin and loosen the turnbuckle which holds the air seal on the ring of the air exit duct. Separate the seal from the exit duct.

d. Disconnect the radiator vent line at the hose connection on the radiator.

e. Disconnect the two coolant lines at the hose connections on the radiator.

f. Remove the one bolt attaching the cooler duct bulkhead assembly to the bracket on the coolant radiator.

g. Remove the nuts from the four bolts which hold the radiator strap assembly to the radiator support. Remove the strap assembly and remove the coolant radiator from the airplane.

2. TO REMOVE THE OIL COOLER AND COOLANT RADIATORS AS AN ASSEMBLY.

a. Remove the side and forward bottom engine cowls. See section IV, paragraph 5, *b*. Drain the coolant system through the two drain plugs, one in the bottom of each coolant radiator.

b. Drain the oil system at the oil "Y" drain valve and the oil cooler drain plug.

c. Remove the three screws from the canvas air seal at forward end of the air exit duct.

d. Remove the safety pins and loosen the turnbuckles which hold the air seals on the air exit duct rings. Separate the air seal from the exit duct.

e. Disconnect the two oil lines from the oil cooler at their hose connections. Reach the hose clamps through the access door in the left side of the air exit duct.

f. Disconnect the vent line from each coolant radiator at the hose connection on the radiator.

g. Disconnect the two coolant lines from each coolant radiator.

h. Remove the two bolts from each of the four radiator mounting brackets and remove the complete oil cooler and coolant radiator assembly from the airplane.

(c) REPAIR OF COOLANT RADIATOR.

1. On airplanes equipped with 87-50-015 brass coolant radiators, the following repair information is applicable:

a. Clean the radiator core with steam for 1/2 hour just before making any repairs. The steam should pass downward into the internal passages with the radiator so placed that the condensation will drain freely from the bottom.

DEMO dimensione ridotta

b. During the cleaning operation, the core air passages must be cleaned of all foreign matter with a long core brush and steam or compressed air.

c. Visually inspect the coolant radiators for the following conditions:

(1) Tube leaks.

(2) Core surface leaks.

(3) Surface leaks between the core and shell assembly.

(4) Dents in core or shell.

(5) Bullet holes in core or shell.

d. Test for invisible leaks. Submerge the radiator in warm water with all openings closed and apply air pressure, not to exceed 50 pounds per square inch. Bubbles will emerge from the points where leaks are located.

e. Surface leaks on the face of the core or between the core and shell assembly should be repaired with a soldering iron instead of a radiator torch as excessive heat may loosen other soldered joints or burn the core metal.

f. When emergency repairs are necessary, individual tubes up to 20 may be plugged temporarily.

2. On airplanes equipped with 87-440-1015 aluminum alloy coolant radiators, the only repair possible is to plug leaky tubes up to a maximum of 60.

(d) INSTALLATION OF COOLANT RADIATORS.

1. TO INSTALL ONE RADIATOR.

a. Place the coolant radiator in the support, install the radiator support strap pad under the straps, where necessary, and install the straps which hold the radiator in the support.

Note

The strap pad consists of a piece of 1/4 inch thick sponge neoprene or equivalent material cut to the width of the strap and about 11 inches long.

b. Install the bolt attaching the cooler duct bulkhead assembly to the bracket on the coolant radiator.

c. Connect the two coolant lines at the hose connections on the radiator.

d. Connect the radiator vent line at the hose connection on the radiator.

e. Pull the air seal over the ring of the air exit duct, tighten the turnbuckle and safety wire.

f. Be sure the drain plugs or drain cocks in the coolant radiators are safety wired.

g. Fill the coolant system. See section IV, paragraph 6, *f*, (5), following.

h. Install the side and forward bottom engine cowls. See section IV, paragraph 5, *b*.

2. TO INSTALL THE OIL COOLER AND COOLANT RADIATORS AS AN ASSEMBLY.

a. Assemble the oil cooler and coolant radiators and install as one assembly.

b. Lift the complete radiator assembly in position and install the eight bolts attaching the assembly to the four radiator mounting brackets on the engine mount.

c. Connect the two coolant lines at the hose connections on each coolant radiator.

d. Connect the coolant radiator vent line at hose connection on each radiator.

e. Connect the two oil lines to the oil cooler at their hose connections near the cooler.

f. Install the air seals over the air exit duct rings. Tighten and install the safety pins in the turnbuckles.

g. Install the three screws attaching the canvas air seal to the forward end of the air exit duct.

h. Be sure the oil "Y" drain valve is closed and the drain plugs or drain cocks in the oil cooler and coolant radiators are safety wired.

i. Fill the coolant system. See section IV, paragraph 6, *f*, (5), following.

j. Fill the oil system. See section IV, paragraph 6, *g*.

k. Install the side and bottom engine cowls. See section IV, paragraph 5, *b*.

(5) FILLING THE COOLING SYSTEM.

(a) A certain amount of air will be left in the forward cylinder jackets when filling the cooling system in the three-point position. Consequently the expansion tank must be filled to the top. The system will hold approximately 15.5 US (12.9 Imperial) gallons.

(b) Inspect entire coolant system for possible leaks.

(c) Replace the filler cap on top of the coolant expansion tank and secure it with safety wire.

g. LUBRICATION SYSTEM.

(1) GENERAL DESCRIPTION.

(a) OIL FLOW THROUGH ENGINE.

1. The oil flows from the bottom of the oil tank through a supply line in which is incorporated the "Y" drain cock to the oil inlet connection on the engine. It is circulated by one pressure pump and returned to the oil tank by two scavenging pumps of the conventional spur-gear type.

2. The oil supplied to the pressure pump from the oil tank is delivered to the exterior of the disc-type oil strainer through a spring-loaded check valve, which prevents oil flow from the tank to the system when the engine is not running. A pressure of only one pound per square inch from oil pump side of the valve is necessary to provide check valve response in opening.

3. The oil strainer is equipped with a safety by-pass valve set to open at a pressure of 100 pounds per square inch.

4. Oil pressure at the outlet of the oil strainer is transmitted to the piston of the adjustable relief valve, which by-passes excess oil directly from

DEMO dimensionata

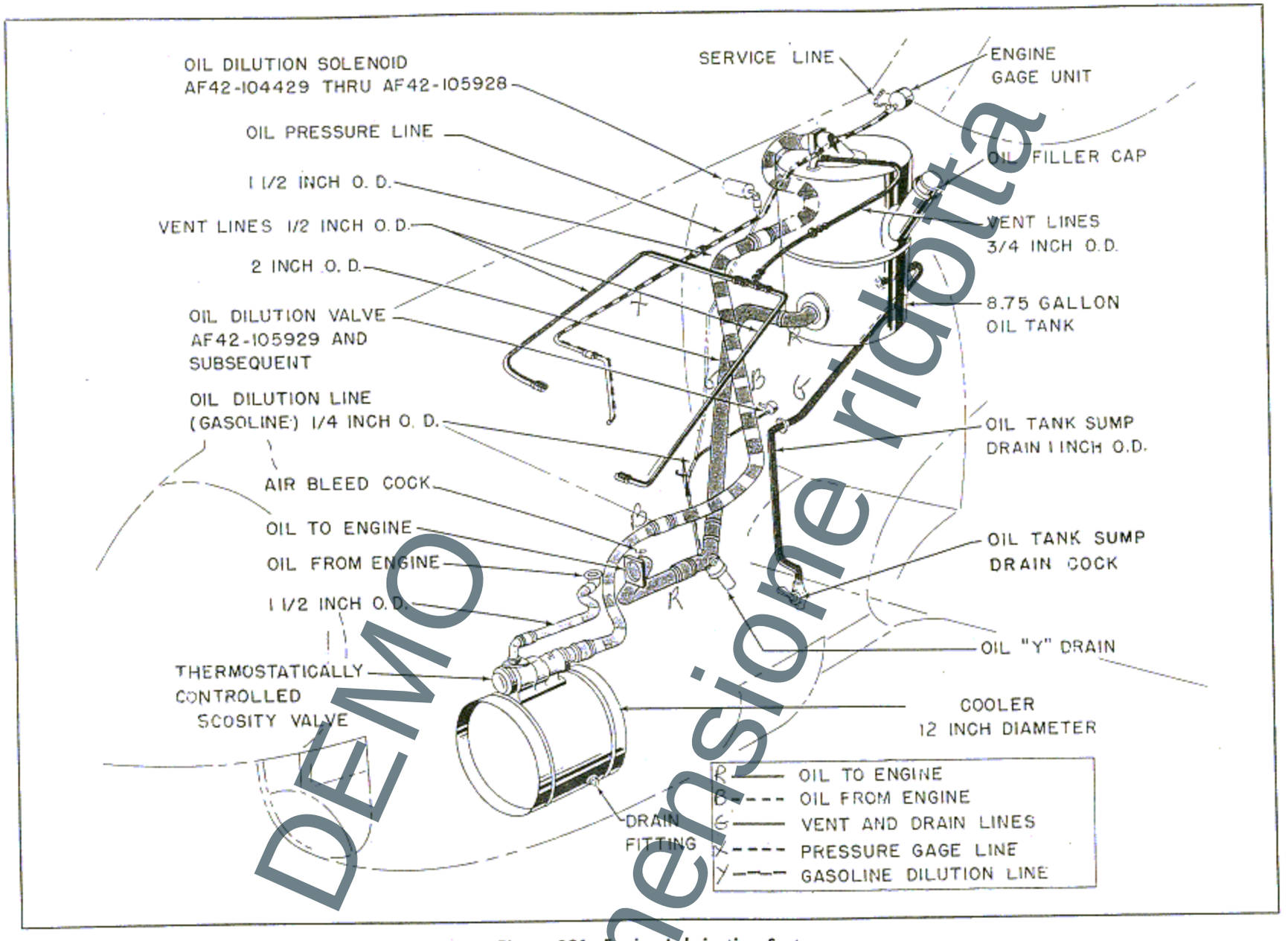


Figure 191—Engine Lubricating System

DEMO dimensione ridotta

the outlet to the inlet of the pressure pump. This arrangement maintains a constant oil pressure in the engine. The relief valve is accessible, for cleaning or oil pressure adjustment, without removal of the oil pump.

5. Oil is distributed from the strainer outlet to the moving parts of the engine. A large tube in the crankcase upper half is connected to a drilled passage in each main bearing web, conveying oil to the main bearings. The main bearings and crankpin journals are fitted with aluminum alloy plugs and are all interconnected to carry oil to the connecting rod bearings from which it is thrown to lubricate the cylinder walls and the piston pins. A continuation of this tube provides oil for the bearings of the reduction gear pinion, the spray on the reduction gear, the propeller governor, and the governor drive bearings.

6. A branch from the lead to the crankcase tube carries oil to the inclined shafts of the camshaft drive and to the magneto drive shaft bearing. Oil is carried through the inclined shafts to the camshaft locating bearing where it enters the hollow camshaft for lubrication of the camshaft bearings and the valve mechanism from a hole in each journal and in the heel of each cam.

7. Three oil passages distribute oil from the oil strainer outlet to the supercharger and all accessory drives contained in the accessories housing.

8. Oil drains through passages at both ends of the camshaft compartment to the crankcase. In level or propeller-end-up positions, all oil drains to the oil pan and is scavenged by the main scavenge pump from the accessories and of the oil pan. The second scavenge pump is located in the reduction gear housing and is driven by the oil plug of the reduction gear pinion. Its inlet is located low in the forward portion of the reduction gear housing so that oil will be scavenged in near vertical positions. The discharge from the forward scavenge pump is carried to the outlet of the main scavenge pump so there is but one oil outlet to the engine.

9. The scavenge pumps circulate the oil from the engine oil outlet through the oil temperature-regulator, the oil cooler and back to the oil tank.

(2) OIL COOLER.—The oil cooler (sometimes referred to as the oil temperature regulator) is contained in a support and strap assembly under the two coolant radiators. A thermostatically controlled rotary type oil temperature control valve mounted on top of the oil cooler controls the flow of oil from the engine through the oil cooler. In operation, the helix bimetal thermostat rotates the rotary valve, allowing the tempered oil to flow through the warm-up passages or to the core section of the oil cooler depending upon the operating conditions. The oil cooler is equipped with either an aluminum alloy or a copper tube core.

(3) OIL COOLER BLANKET. *(See figure 192.)* —A one inch oil cooler blanket ring, part No. 87-46-721, is provided as loose equipment. The blanket ring

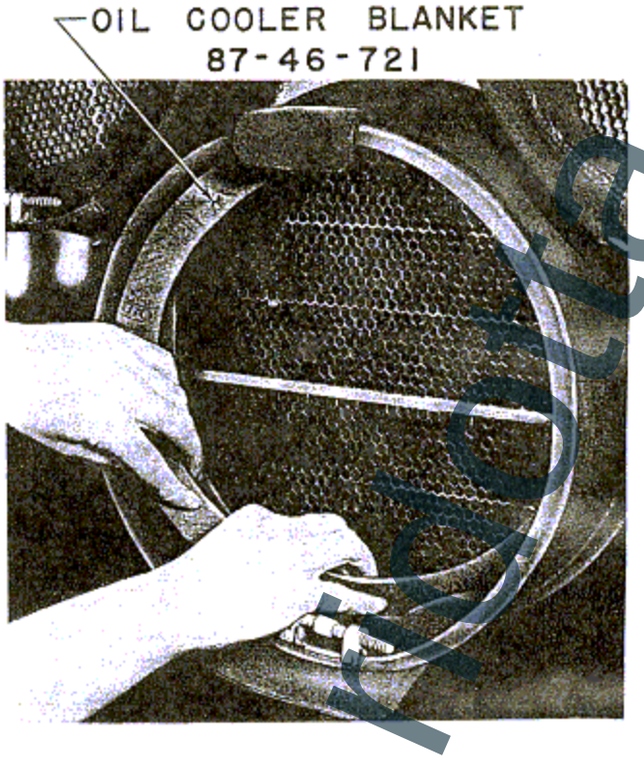


Figure 192—Installing Oil Cooler Blanket

is installed simply by placing it inside the oil cooler housing against the front face of the core. The air pressure will hold it in place. The blanket ring prevents the flow of cold air through the outer portion of the oil cooler core and thus keeps the oil warm and permits it to circulate more freely. The oil cooler blanket ring should be installed when the ground air temperature is −9°C (+15.8°F) or below. If for any reason the engine oil temperature is in excess of 90°C (194°F) the oil cooler blanket should be removed.

(4) OIL TANK.

(a) DESCRIPTION.—The oil tank is located aft of the firewall and forward of the armor plate installation at station 2 and is accessible by removing the fuselage cover between the firewall and windshield. The oil tank contains a hopper which keeps the oil in circulation and returns the same oil to the engine without mixing it with all the oil in the tank, but withdrawing additional fresh oil from the tank as needed. This is an aid in warming up the engine and also helps in oil dilution. Two vent tubes, one from the right and the other from the left side of the engine, connect to the tank at a single union. The oil tank is equipped with a pendulum assembly at the oil outlet which has a travel vertically of 75 degrees and horizontally of 15 degrees either side of the pendulum

Do not dimension from this

center line. The pendulum assembly is designed so that the mouth of the pendulum is always below the oil level in the tank regardless of the flight attitude of the airplane, thus insuring a constant supply of oil to the engine oil pump.

The tank capacity is 8.75 US (7.3 Imperial) gallons. The tank should be filled to the top of the filler neck before each flight. The filler cap is reached by means of an access door on the left top of the fuselage forward of the windshield. (See figure 25.)

(b) REMOVAL OF OIL TANK.

1. Drain the oil tank through the oil "Y" drain valve and the oil tank sump drain.

Note

The oil "Y" drain and the oil tank sump drain are accessible through the two access doors, marked "OIL DRAIN" that are located in the air exit duct just aft of the cowl flaps.

2. Drain the oil cooler.

Note

The oil cooler drain plug is accessible through the access door marked "OIL DRAIN—COOLANT DRAIN" on the bottom of the "bath tub" cowl.

3. Remove the fuselage forward plate cover between stations 1 and 2.

4. Disconnect the vent and the oil return line at the top of the oil tank. Disconnect these same two lines at a point forward of the firewall and below the coolant tank and remove these lines from the firewall.

5. In the cockpit, remove the gun sight and the gun sight support by removing the four bolts which hold the gun sight support to the armor plate.

6. Disconnect the engine oil supply line at the elbow on the bottom of the tank.

7. Disconnect the elbow fitting at the tank.

8. Disconnect the oil tank sump drain on the lower rear of the tank.

9. Detach the upper cradle assembly by removing the four nuts holding it to the firewall and armor plate.

10. Remove the filler cap and pull the scupper off the filler neck.

11. Remove the tank from the padded mountings in the lower cradle by raising it up straight.

(c) REMOVAL AND DISASSEMBLY OF OIL TANK PENDULUM.

1. Remove the ten screws that fasten the bottom inspection cover to the tank plate and remove the cover.

2. Hold the pendulum assembly with one hand through the bottom inspection hole while removing the six screws which attach the pendulum assembly to the oil outlet plate.

3. Carefully remove the pendulum assembly through the inspection hole. If disassembling more than one pendulum at a time, it is very important to keep the parts of each assembly together because of the close tolerance of the parts, insuring a snug fit of the base of the pendulum and a complete freedom of movement of the pendulum without binding in its operation.

4. The pendulum may now be disassembled by removing the three nuts that fasten the base to the pendulum.

(d) REPAIR OF OIL TANK.

1. Minor damage to the tank skin can be successfully repaired wherever soldering or welding equipment is available. Whenever structural damage has occurred to a tank, send it to a repair depot where the necessary equipment is available for such repairs.

2. To eliminate danger from possible ignition of explosive gases when repairing aircraft oil tanks, the following precautions must be taken:

a. No repairs requiring the application of heat will be attempted on oil tanks installed in an airplane.

b. After removal the oil tank will be flushed for 15 minutes with hot water entering at the bottom of the tank and overflowing at the top.

c. After flushing with hot water, clean the oil tank with live steam, passing the steam through the tank for a minimum period of one hour. The tank will be mounted so that there is an opening at the top and one at the bottom, at the lowest point of the tank. The live steam will be fed in at the top opening and allowed to escape through the bottom opening. All other openings will be closed.

WARNING

Never use a hot soldering iron to solder oil tanks without using the previously described steam-cleaning method or the following warm water method. A hot iron could ignite explosive gases.

d. Flush hot water through the bottom of the tank and out the top for a minimum period of one hour. Plug all openings except the one nearest the damaged portion of the tank and fill nearly full with warm water.

Position the tank so that the unplugged opening and the damaged surface will be at the top.

With the tank in this position add water nearly up to the hole or crack to be repaired so that no space will be left for the formation of explosive gases. The tank may then be safely soldered or welded.

e. When the exterior of the oil tank is to be cleaned with paint remover or any combustible solvents, this cleaning will be done prior to flushing or steaming of the interior of the tank.

f. The repair work should be done as soon as possible after the tank has been cleaned. Under no circumstances will a tank that has been flushed or steam-cleaned be allowed to stand more than 30 minutes before being repaired. Tanks that are allowed to stand in excess of this period will be recleaned before applying any heat.

DeMo dimensionata

g. Welding of oil tanks that have contained oil will not be attempted near any combustible materials or in any building containing such materials.

3. Failure in an oil tank can usually be repaired by simply welding the crack. The paint coatings should first be removed for a distance of at least three inches all around the crack. This can be done by the application of paint remover.

4. Drill a small hole (3/64 to 1/16 inch in diameter) at each end of the crack to prevent its progression under the welding heat or after the tank is again in service. The welding can then be accomplished, using an oxygen-hydrogen flame. The flame should be adjusted to a neutral condition with the hydrogen gage set about five pounds per square inch above the oxygen gage. A filler rod of the same material as the tank shell can be used, although five percent silicon rod, if available, is generally easier to handle and gives better results in complicated welds. United States Aluminum Company Flux 22, or equivalent, should be used. It is mixed to a paste condition with water, the surface to be welded is coated with it, and the rod dipped in it. Enough heat should be applied to form a bead on the inside of the joint being welded, but care should be exercised to prevent melting holes in the material. A good practice to follow is to weld from each end of a crack toward the center to prevent the crack's progressing ahead of the flame.

5. Before installing the oil tank in the airplane, test the tank under warm water with five pounds per square inch air pressure in the tank.

(e) ASSEMBLY AND INSTALLATION OF OIL TANK PENDULUM.

1. Replace the three nuts that fasten the base to the pendulum.

2. Carefully replace the pendulum assembly through the inspection hole.

3. Hold the pendulum assembly with one hand while replacing the six screws which attach the pendulum assembly to the outer plate.

4. Replace the cover and ten screws that fasten the bottom inspection cover to the tank plate.

(f) INSTALLATION OF OIL TANK.

1. Dry and clean the inside of the tank with compressed air.

2. Lower this tank on the padded and asbestos covered mountings in the fuselage.

3. Replace the scupper on the filler neck and the filler cap.

4. Attach the cradle assembly to the fuselage by replacing the four nuts holding it in place.

5. Connect the oil tank sump drain on the lower rear of the tank.

6. Connect the elbow fitting at the bottom of the tank.

7. Connect the engine oil supply line to the elbow on the bottom of the tank.

8. Connect the vent and oil return lines at the top of the oil tank and at a point forward of the firewall and below the coolant tank.

9. Replace the gun sight and gun sight support with the four bolts holding the gun sight support to the armor plate.

10. Tighten and safety wire all connections.

11. Replace the fuselage forward plate cover between stations 1 and 2.

12. Close the "Y" and sump drain cocks and safety wire.

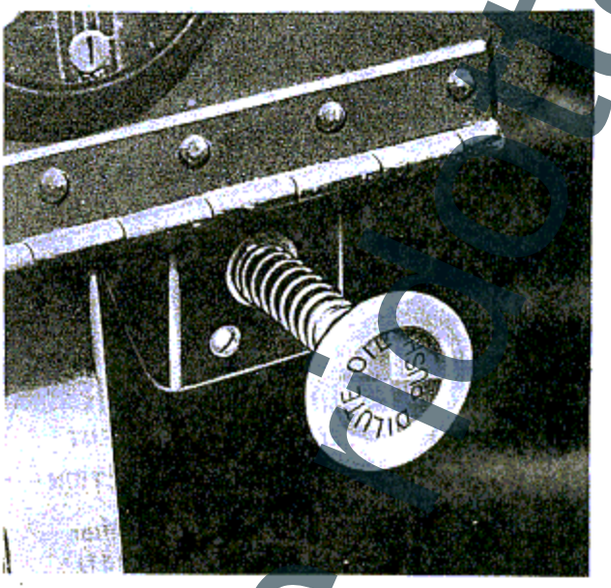


Figure 193—Oil Dilution Control

(5) OIL DILUTION SYSTEM.

(a) An electrically operated oil dilution valve is installed on the upper right side of the firewall on airplanes AF42-104429 through AF42-105928. (See figure 172.) The valve is operated by a solenoid which is controlled by a switch on the main switch panel.

(b) A manually operated oil dilution valve is installed on the lower center of the firewall on airplanes AF42-105929 and subsequent. The valve is controlled from the cockpit by a push-pull control under the main switch panel. (See figure 193.)

(c) The oil dilution valve introduces fuel obtained from the carburetor into the oil inlet line at the oil "Y" drain valve. The oil dilution system is operated when a cold weather start is anticipated. Proper oil dilution procedure for the P-40N series airplanes is given in Technical Order 01-25CN-30, Cold Weather Operations and Maintenance Instructions for the P-40N Series Airplanes.

(6) OIL PRESSURE TRANSMITTER.

(a) DESCRIPTION. — For airplanes AF42-105929 through AF43-23151 the type A-1 diaphragm type oil pressure transmitter is installed and is attached to the right engine mount. (See figure 194.) The purpose of the transmitter is to transmit the engine oil pressure to the gage unit on the instrument through a liquid medium having low viscosity. The line between the oil pressure gage and the transmitter

DEMO dimensione.ta

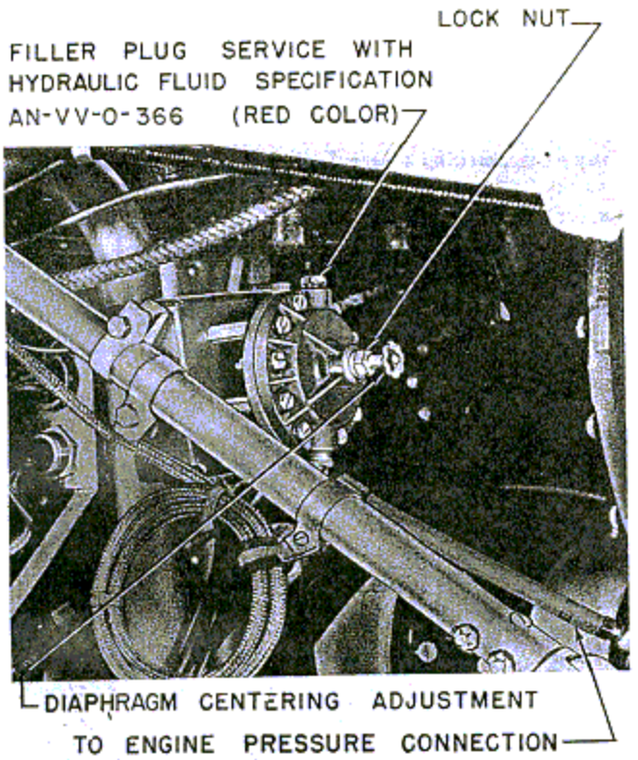


Figure 194—Oil Pressure Transmitter (AF42-105929 through AF43-23151)

is serviced with compass liquid, Specification AN-VV-C-551; the line between the transmitter and the pressure connection on the engine is serviced with hydraulic fluid, Specification AN-VV-O-366 (red color). For AF43-23152 and subsequent airplanes, the transmitter is not installed. Instead, the oil pressure line is serviced with hydraulic fluid, Specification AN-VV-O-366. This line is filled by means of a hand gun through the oil gage service fitting on the right side of the instrument panel.

(b) SERVICING THE OIL PRESSURE TRANSMITTER.

1. To fill the transmitter chamber with compass liquid, unscrew the lock nut (5) from the threaded portion of the shaft. Then push the shaft in to the full limit towards the center of the transmitter assembly. Turn the thumbwheel (6) clockwise until the backing plate at the end of the shaft is set firmly against the diaphragm as shown in figure 195.

2. To gain access to the bleeder cap (C) of the oil pressure gage line, remove the two retaining screws in the top of the instrument panel and tip the panel assembly aft to obtain sufficient hand space.

3. Remove the bleeder cap (1) and install a threaded bleeder tube (2) in place of the cap just removed. Allow the other end of the bleeder tube to terminate in small bleeding liquid receptable (3).

4. Fill the small hand gun (7) with compass liquid, Specification AN-VV-C-551 and attach at (8) on the transmitter. Slowly operate the hand gun to force the liquid up through the transmitter and the oil pressure gage line and out through the bleeder tube into the receptacle. With the bleeder tube below the surface of the liquid in the receptacle, operate the hand gun until all air is expelled from the line and the compass liquid flows evenly out the bleeder tube. Disconnect the bleeder tube (2) and reinstall the cap (1). Disconnect the hand gun from the filler connection (8) of the transmitter and replace the cap.

5. Return the diaphragm backing plate to its normal position by turning the thumbwheel (6) counterclockwise until the shaft can be pulled out. Tighten the lock nut (5).

6. Return the instrument panel to its original position and install the retaining screws.

7. To fill the transmitter chamber on the opposite side of the diaphragm and the engine oil pressure inlet line with hydraulic fluid proceed as follows:

a. Disconnect the engine oil pressure inlet line (H) at the connection on the engine.

b. Remove the plug (4) at the top of the transmitter front chamber, and using a hand oil squirt can containing hydraulic fluid, Specification AN-VV-O-366 (red color), inject the fluid into the transmitter chamber allowing it to flow through the chamber and out the oil pressure line.

c. When the fluid flow is established and clean, reconnect the engine oil pressure line (9), and continue to inject the fluid until the chamber and the line are filled. Replace the plug (4) and safety wire. The transmitter is now ready for operation.

8. The transmitter must be serviced every 50 hours flying time with a new diaphragm and fluid in both chambers.

CAUTION

To prevent possible danger to the diaphragm, the pressure used to inject the compass liquid must not exceed 20 pounds per square inch. The use of compressed air filling tanks is not advised, as air entering the system with liquid will cause malfunctioning in service.

(7) FILLING THE OIL SYSTEM.—When the oil system is completely drained, the following procedure is recommended. Fill the tank to the top of the filler neck. Start the engine, run until the oil temperature is approximately 70°C (158°F), wait five minutes, and then check the oil level. If necessary, make additions to bring the level up to the neck.

DEMO dimensione rigata

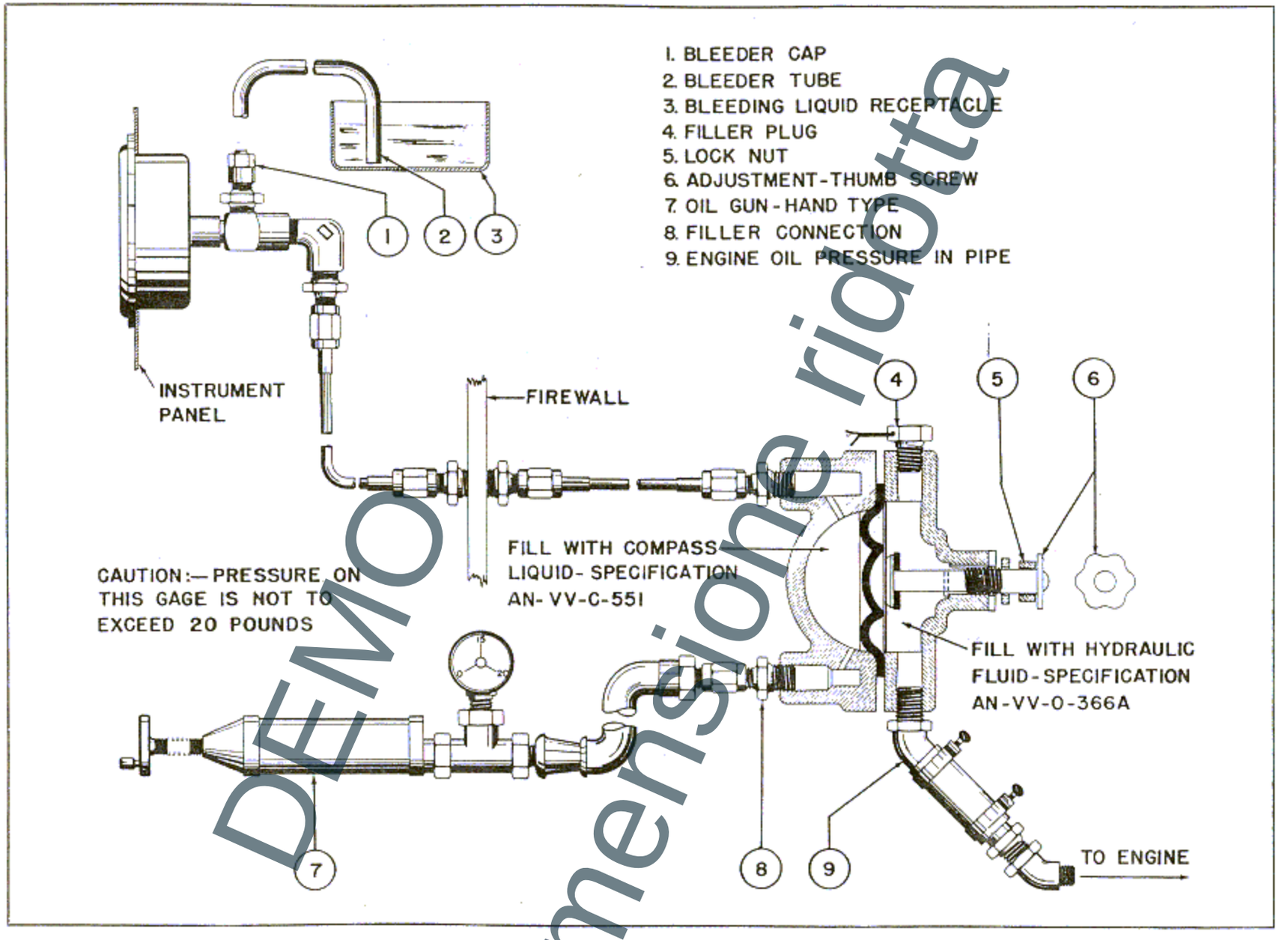
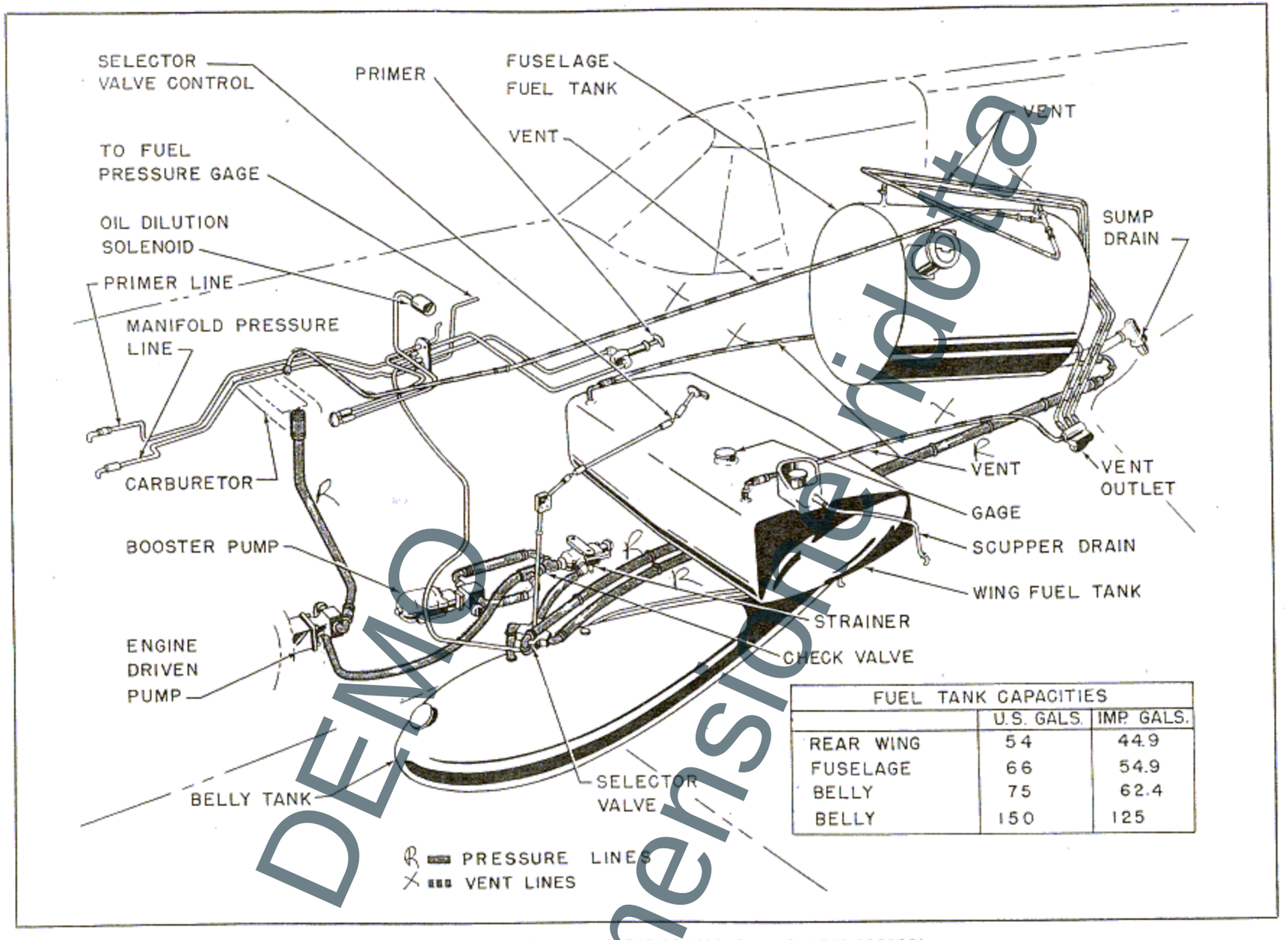


Figure 195—Servicing Oil Pressure Transmitter

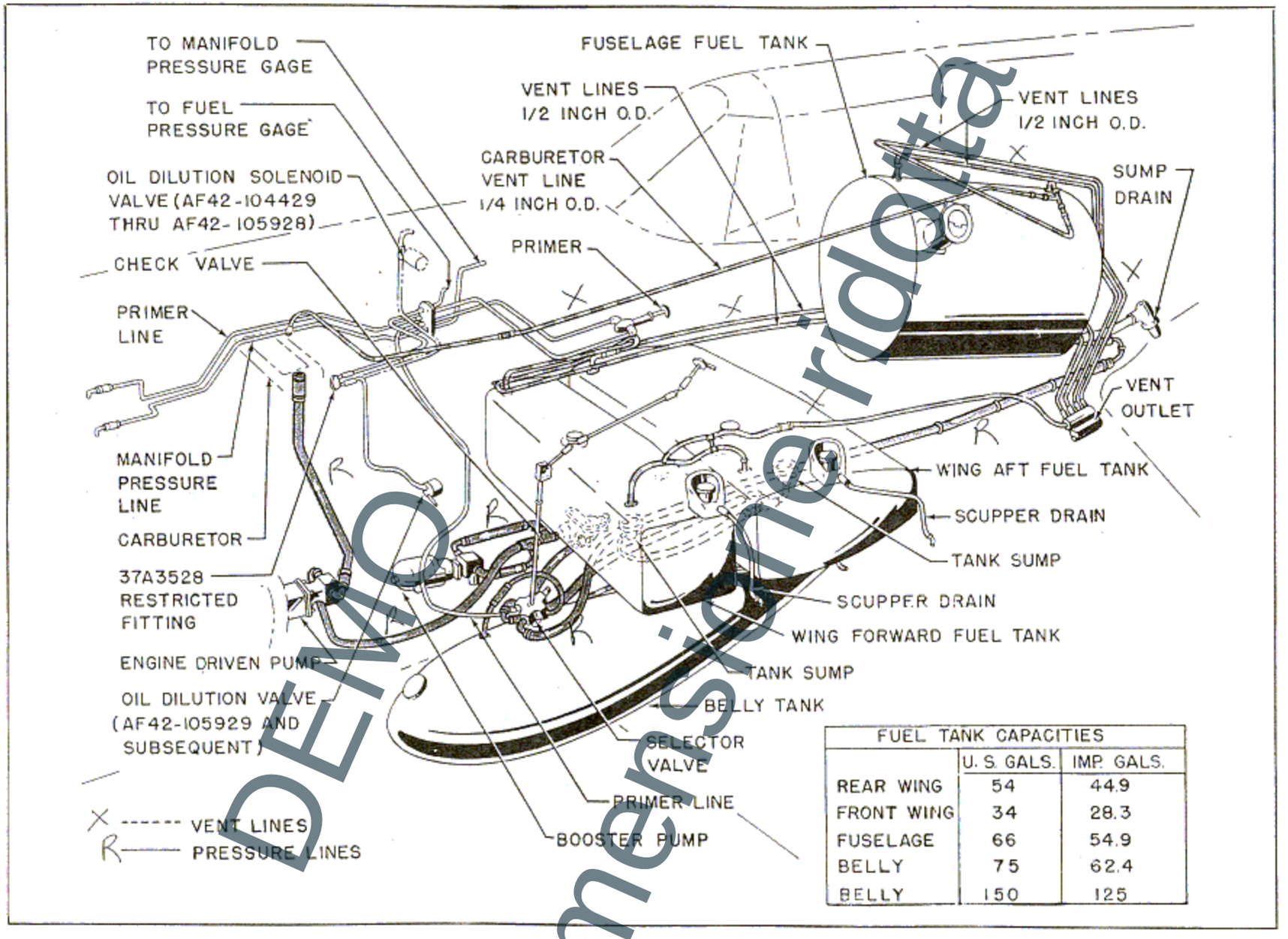
DEMO dimensione ridotta



FUEL TANK CAPACITIES		
	U.S. GALS.	IMP. GALS.
REAR WING	54	44.9
FUSELAGE	66	54.9
BELLY	75	62.4
BELLY	150	125

Figure 196—Fuel System (AF42-104429 through AF42-105128)

DEMO dimensionata



FUEL TANK CAPACITIES		
	U. S. GALS.	IMP. GALS.
REAR WING	54	44.9
FRONT WING	34	28.3
FUSELAGE	66	54.9
BELLY	75	62.4
BELLY	150	125

Figure 197—Fuel System (AF42-105129 and Subsequent)

DEMO
dimensione ridotta

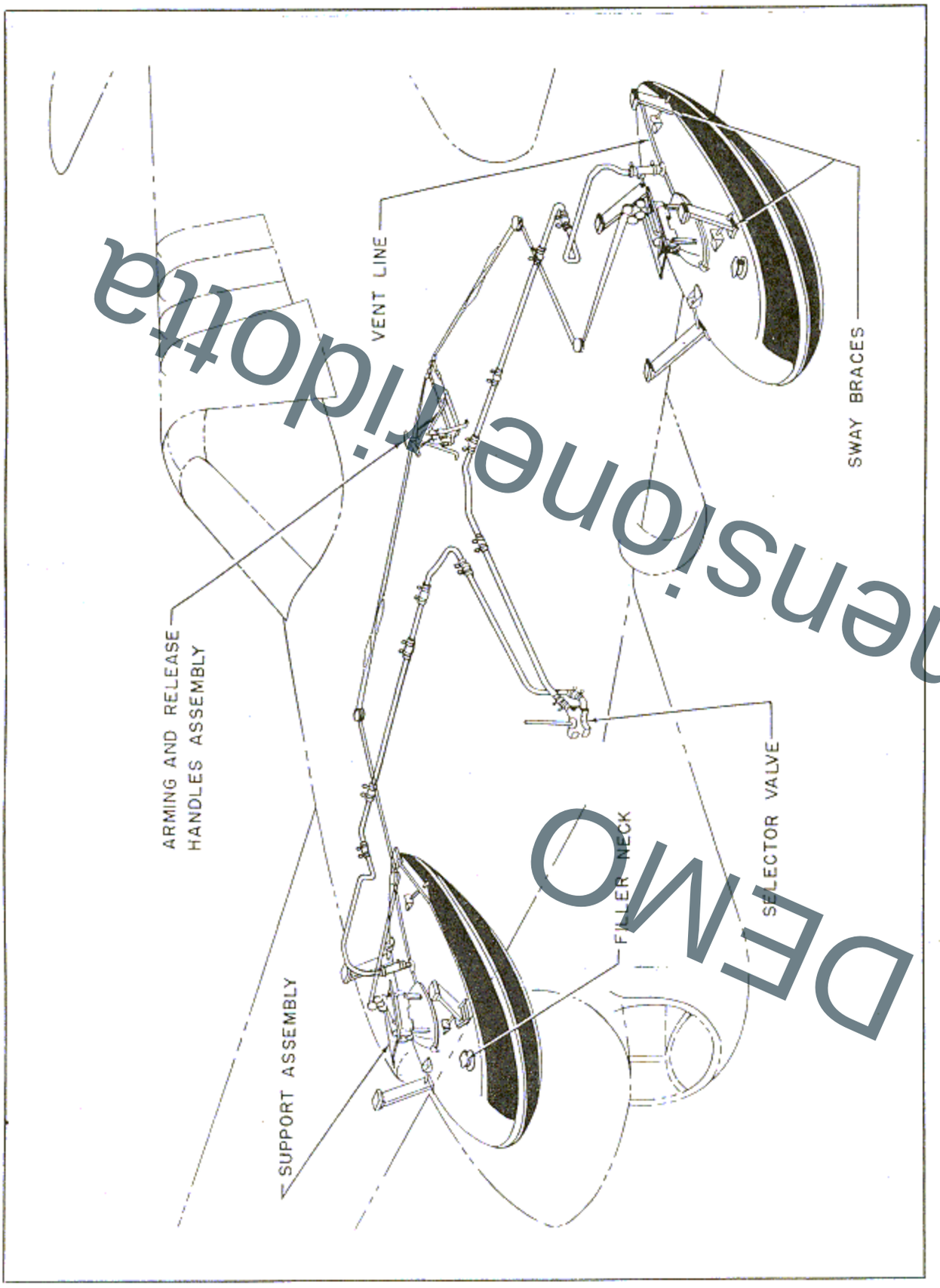


Figure 198—Long Range Fuel System

DEMO dimensionevitalia

b. FUEL SYSTEM. *(See figures 196 and 197.)*

(1) GENERAL DESCRIPTION. — Three self-sealing cells, one located in the fuselage and two in the wing, afford the normal fuel tankage of the P-40N airplane. Provision is made for the installation of a belly tank and two auxiliary wing tanks for long range flying. An engine-driven pump and an electric booster pump, both of the G-9 type, provide pressure for the system. A Lunkenheimer C-4 strainer, a five port selector valve, complete ventilation, and self-sealing tubes are the chief additional features of this fuel system.

(2) TANKS.

(a) DESCRIPTION.—Each of the two auxiliary wing tanks holds 225 US (187.5 Imperial) gallons. The capacity of the other tanks is given in figure 197. The wing tanks are located beneath the cockpit floor; the fuselage tank is to the rear of the pilot immediately aft of station 5 bulkhead. The belly tank is fastened to the bomb shackle beneath the wing on the center line of the airplane, the auxiliary wing tanks to the outboard wing bomb carriers. (See figure 198.)

All tanks are vented to the atmosphere. The wing and fuselage tanks vent lines drain at a "gang" drain in the trailing edge of the wing fillet on the left side of the airplane. A vent line connects the carburetor fuel chamber to the top of the fuselage tank. This vent allows air to be expelled from the top of the carburetor fuel chamber when it is being filled and prevents vapor lock. The passage is closed by a check valve when the chamber is full. All fuel tanks contain an internal division system to trap fuel in a bank or side slip, assuring ample available fuel in such maneuvers.

(b) TO REMOVE THE BELLY TANK.

1. Drain the tank through the drain cock on the bottom of the tank and be sure that all safety precautions are taken to prevent fire or explosion. Have at least two hand fire extinguishers within reach.

2. Unbutton the oil drain access door on the right side of the exit duct and loosen the two clamp fittings on the synthetic rubber hose connection on the fuel supply line to the selector valve. Take the synthetic rubber cap from the tool kit and install it on the end of the fuel selector valve line.

3. Remove the two nuts and washers from one side of the sway brace assembly and remove the assembly.

4. Unbutton the fuel tank drain-access door and, with a man supporting the tank at the forward and aft ends, insert a hand in the access door opening and pull back on the release lever at the front of the shackle. This procedure will release the carrying hooks and allow the tank to drop free of the shackle. Use extreme caution when removing the belly tank not to damage the short feed line connection on top of the tank. Remove the tank from under the airplane, and if the tank is not completely empty, be sure to keep the tank upright until it is thoroughly drained. Spilling fuel creates a dangerous fire hazard, and extreme care should be exercised to guard against it. If fuel is accidentally spilled, clean it up immediately.

(c) TO INSTALL THE BELLY TANK.

1. If the sway brace channels are not installed in the wing panel, install them. The front channels are installed on web 2 at 16.375 inches from the airplane center-line. The rear channels are installed on web 3 at 16.78 inches from the airplane center line.

2. Unbutton the front tank fuel drain access door on the keel fairing and insert a hand to pull the release lever back until the carrying hooks are open.

3. With a man at each end of the belly tank, raise the tank and guide the fuel supply line on top of the tank into the synthetic rubber fitting on the botton of the exit duct forward of the bomb shackle.

4. Raise the tank until the lugs on the top of the tank are inserted in the slots on the bomb shackle.

5. Insert a hand through the fuel drain access door, push the two carrying hooks up to the lock position and pull back on the release lever on the bomb shackle approximately one inch to engage the carrying hook locks.

6. Unbutton the oil drain access door on the right side of the exit duct. Working through this access door remove the synthetic rubber cap on the fuel line to the fuel cock and complete the connection between the tank line and fuel cock line with a short length of synthetic rubber hose. Tighten the clamps at either end of the hose connection. Stow the synthetic rubber cap in the tool kit on the duffle bag.

7. Install the sway brace boards in the channels on the wing and tighten the front and rear strap assemblies so that the belly tank is in line with the airplane center line.

(d). TO REMOVE EITHER WING TANK.

1. Remove the inboard fixed-landing-gear fairing.

2. Disconnect and remove the belly tank sway braces.

3. Remove the keel fairing.

4. Remove the wing fillets.

5. Drain the fuel cells.

6. Disconnect the vent lines at the top of the fuel cells above the upper wing skin.

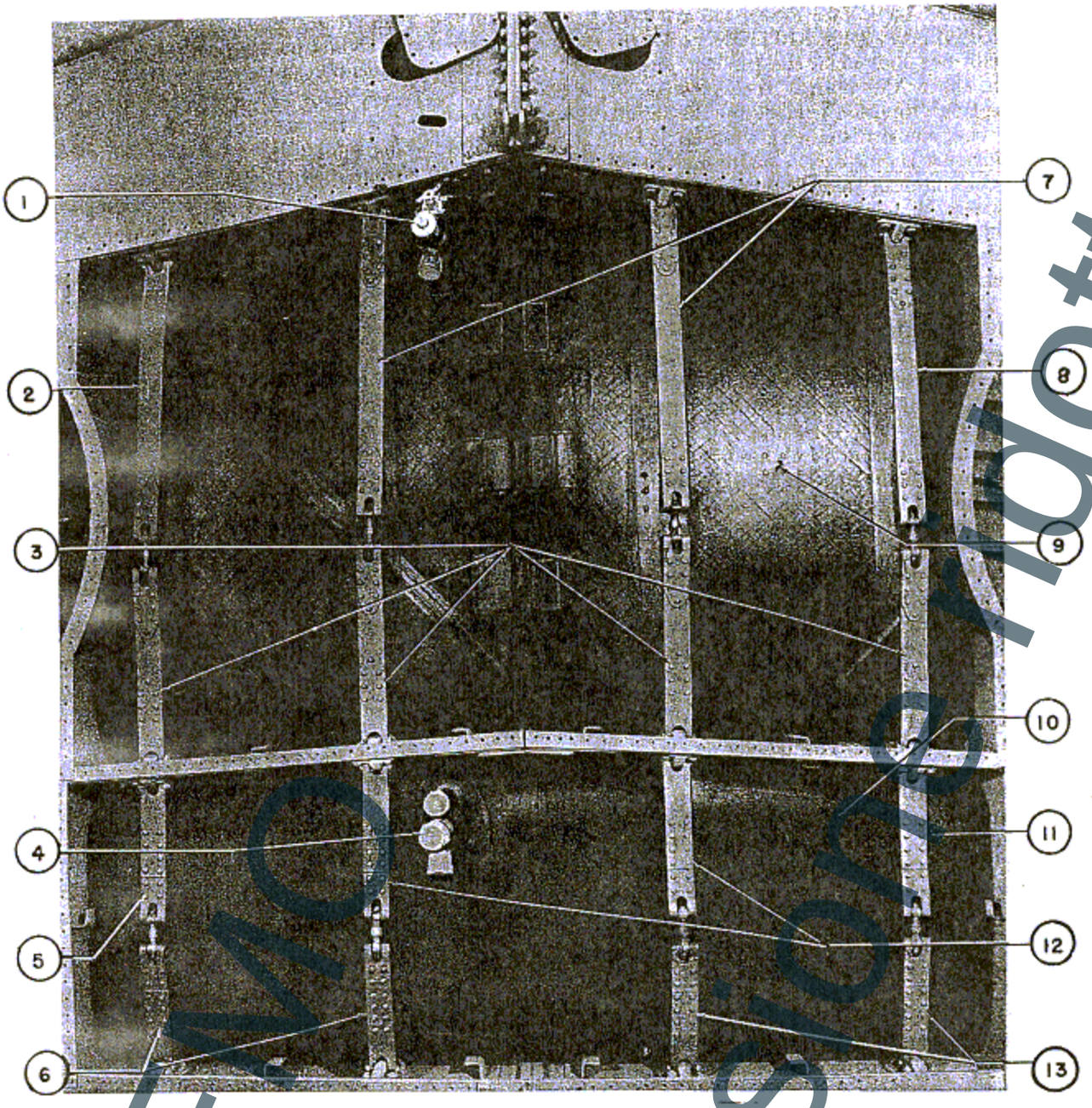
7. Remove the control cables and the belly bomb shackle.

8. Remove fuel lines, fuel gages, and filler caps. All connections to the self-sealing fuel cells must be broken, otherwise they will be torn at the fittings.

9. Remove the filler cap on the filler neck and then unscrew the filler neck, using tool 87-88-596, by inserting the tool into the slots on the circumference of the filler neck.

10. Remove the fuel tank doors in the bottom of the wing as a single unit as follows:

DEMO dimensionerrotta



1. 87-45-071 SUMP
2. 87-44-568 L STRAP
3. 87-44-567 L/R STRAPS
4. 87-45-071 SUMP
5. 87-44-059 L STRAP
6. 87-44-057 L STRAP
7. 87-44-569 L/R STRAPS
8. 87-44-568 R STRAP
9. 87-423-1001 REAR WING FUEL TANK
10. 87-423-1000 FRONT WING FUEL TANK
11. 87-44-059 R STRAP
12. 87-44-058 L/R STRAPS
13. 87-44-057 R STRAPS

Figure 199—Installation of Wing Tanks

DEVIATIONS dimensions Piaggio

a. Withdraw the bolts at each end of the skid, which attach the skid to the match angles.

b. Remove all screws and bolts which attach the doors to the wing, including the screws and bolts through web 3.

11. Loosen the tank strap turnbuckles and remove the straps. (See figure 199.)

12. Remove the fuel tank, from the tank compartment taking care not to damage the filler neck, gage, and vent line fittings on the tank. (See figures 200, 201, 202, and 203.)

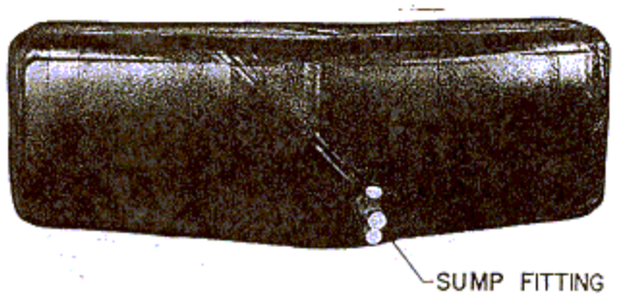


Figure 200—Front Wing Fuel Tank—Bottom View

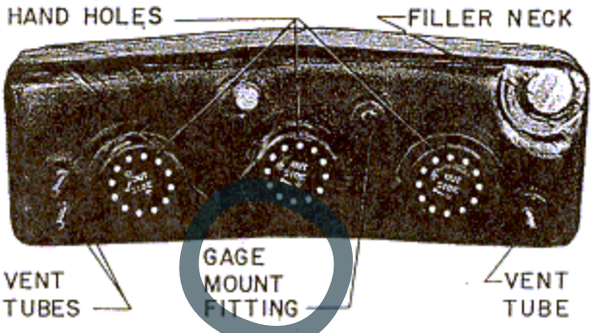


Figure 201—Front Wing Fuel Tank—Top View

Note

Additional information for removing the wing fuel tanks is given in section IV, paragraph 1, *a,* (2), (b).

(e) TO INSTALL EITHER WING TANK.—Complete instructions for installing the wing fuel tanks are contained in section IV, paragraph 1, *a,* (3), (a).

(f) TO REMOVE THE FUSELAGE TANK.

1. Remove the aft keel fairing and drain the fuel from the tank.

CAUTION

Exercise every precaution to reduce fire hazards.

2. Working through the fuselage access door, remove the duffle bag, the radio transmitters and receivers on the shelves forward of the door, and the top radio shelf attached to bulkheads 8 and 9. Remove the radio receiver and transmitter unit from the shelf aft of the access door if one is installed.

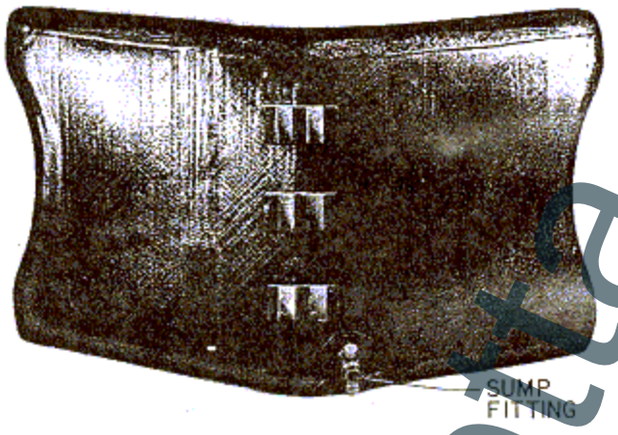


Figure 202—Rear Wing Fuel Tank—Bottom View

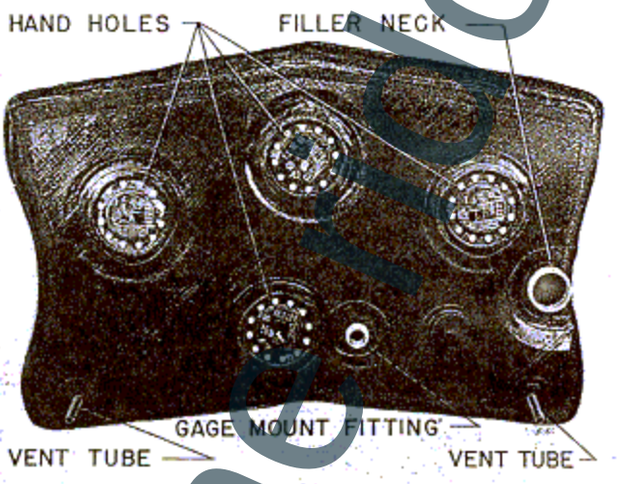


Figure 203—Rear Wing Fuel Tank—Top View

3. Climb through the access door into the fuselage and disconnect the fuel supply line at the bottom of the tank. Disconnect the rear vent line at the top of the tank. Cut the lock wire and disconnect the turnbuckle at the aft end of the tank and the rear tie-down strap at the top of the tank. Disconnect the bonding tab at the nut plate on the tank to the right of the sump assembly.

4. Remove the oxygen cylinder above the fuel tank at station 6 bulkhead.

5. Working from within the cockpit, remove the pilot's seat.

6. Remove the pilot's headrest.

7. Remove the armor plate at station 5 bulkhead.

DEMO dimensione.ota

8. Remove the bonding tabs, one on the right side of the tank and the other on the filler neck.

9. Disconnect the electric conduit at the gage transmitter.

10. Remove the short pipe elbow from the forward vent line on the top of the tank.

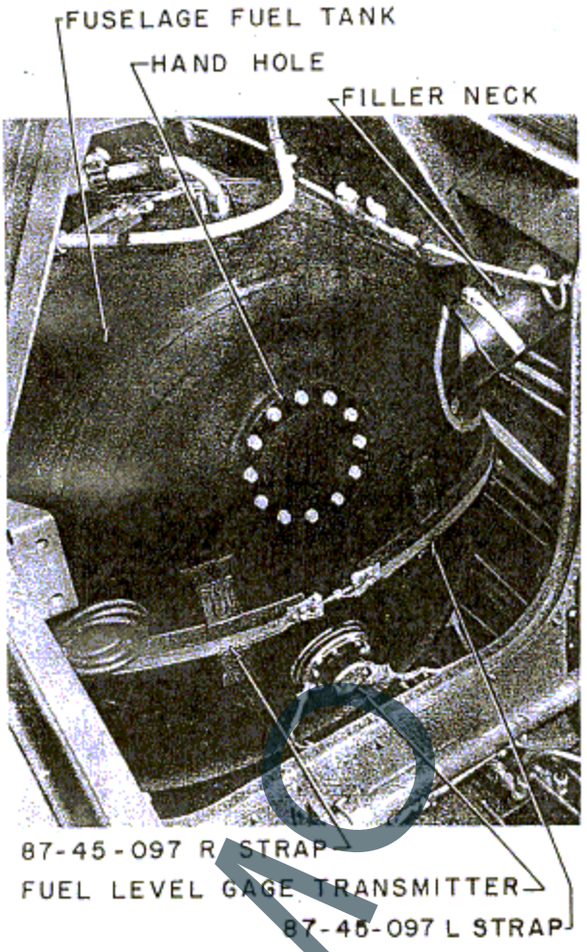


Figure 204—Fuselage Fuel Tank Installation

11. Cut the lock wires and disconnect the turnbuckles on the forward tie-down and retaining straps. (See figure 204.)

12. Loosen the two clamps on the filler neck and remove the filler neck cap and adapter. Remove the seven screws around the circumference of the filler neck on the outside of the fuselage skin and remove the nut plate and filler neck.

13. Remove the hydraulic hand pump handle and stow it under the right rudder pedal.

14. Remove the control stick and push-pull rod and lay the assembly on the cockpit floor to act as a skid.

15. Remove the canopy control crank on the right side of the fuselage.

16. Remove the gun sight.

17. Place the landing gear control handle in the "DOWN" position.

18. Place the cowl flap control in the open position and all other controls in their forward positions.

19. Place a pad on the floor of the cockpit.

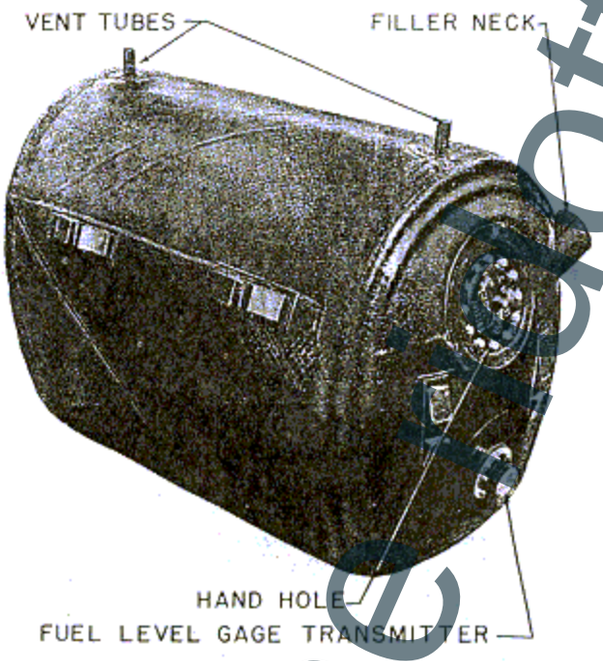


Figure 205—Fuselage Tank—Right Front View

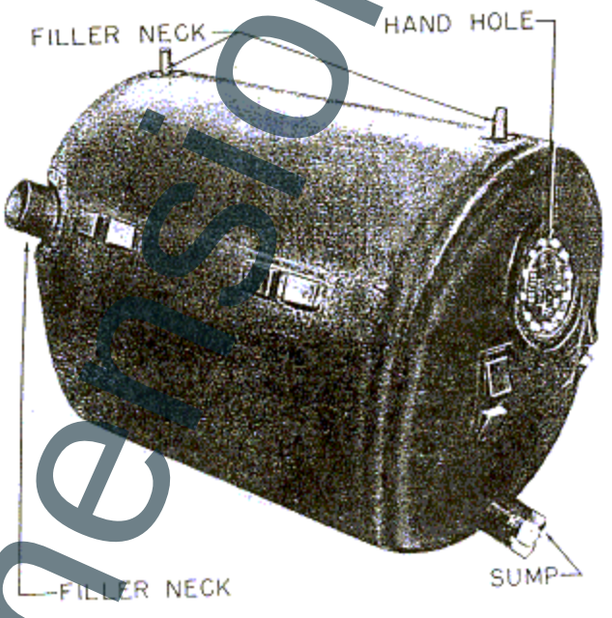


Figure 206—Fuselage Tank—Left Rear View

DEMO dimensione aerotta

20. With one man in the fuselage to apply a forward force and one man in the cockpit to grasp the tank at the transmitter and lift it over the bulkhead at station 5, move the tank carefully into the cockpit.

21. Move the tank as far forward as it will go and start to tip the rear of the tank upward. Work the tank back and up until it is in a vertical position. Lift the tank straight up out of the cockpit. (See figures 205 and 206.)

Note

On airplanes AF42-104829 and subsequent, it will be necessary to remove the cockpit canopy, the rear vision installation, and the plate on the rear deck in order to remove the fuselage tank.

(g) TO INSTALL THE FUSELAGE TANK.

Note

Extreme care should be exercised when installing the fuselage tank so that damage to the tank assembly, cockpit controls and pipes and fittings, will be avoided. Two men are required to install the tank.

1. Before the installation of the fuselage tank, check over the cockpit for the following items:

a. Removal of flight control stick and push-pull tube.

b. Removal of hand hydraulic pump handle.

c. Removal of canopy control crank.

d. Removal of gun sight.

e. Removal of bomb-tank release and arming controls from the cockpit floor.

Note

In airplanes AF43-24252 and subsequent, the bomb-tank release and arming controls are located on the left cockpit wall. On airplanes prior to AF43-24252, the location of the controls will be changed to the left cockpit wall at the discretion of the Army Air Forces.

f. Landing gear control handle in "DOWN" position.

g. Cowl flap control in "GROUND COOLING" position.

2. Before installation of the fuselage tank, check over the fuselage for the following items:

a. Removal of radio equipment from top and center shelves forward of fuselage access door, and removal of top shelf.

b. Condition of all control cables, pulleys, electric conduit, and other installations in fuselage forward of fuselage access door.

c. Condition of synthetic rubber pads on fuselage bulkheads at stations 6 and 7. If these pads are worn, replace them. Make sure the pads are in place on the bulkheads.

d. Condition of all tank straps, synthetic rubber pads, strap fittings and turnbuckles. Replace worn rubber pads, strap fittings and turnbuckles. Replace worn strap bolts or bolts or turnbuckles having stripped threads. If new straps are to be installed, insert a strap bolt in each tie-down fitting to test the fit of the bolt. If the bolt does not fit freely, using a punch and hammer, spread the fittings so that the bolts will fit freely but not loosely before attempting to install the straps on their fuselage fittings.

3. Install the fuselage tank filler neck.

a. Before installation inspect the synthetic rubber filler neck for breaks and deterioration and install a new one if necessary.

b. Place the nut plate against the filler neck flange and attach the filler neck to the fuselage by installing the seven screws through the fuselage skin, filler neck flange, and the nut plate.

Note

Use an awl or a punch to align the holes in the fuselage skin with the holes in the filler neck flange and the nut plate. Install the top screw first and work around the opening until all screws are installed.

c. Insert the cap and adapter assembly into the filler neck. Push the cap in until it is flush with the fuselage skin and turn the cap handle so that it parallels the line of thrust.

d. Install the clamp on the filler neck, close to the fuselage skin, to hold the filler cap adapter in the neck.

4. Place a pad on the floor of the cockpit.

5. Raise the tank to the walkway on the wing and move it up even with the cockpit opening.

6. With two men on the wing, tip the tank so that the forward end is down and raise the tank up until it rests on the cockpit sill. One man can now balance the tank while the other takes his place on the opposite side of the cockpit.

7. Lift the tank off the sill and allow it to lower into the cockpit with the tank still in a vertical position until it rests on the pad on the cockpit floor.

8. Grasp the forward end of the tank resting on the cockpit floor with one hand and lift up slightly on the tank while turning the aft end downward. Keep on working the tank to a horizontal position being extremely careful not to foul any of the controls or instruments in the cockpit.

9. After the tank is about half way down, one man should straddle the tank and grasp the tank both fore and aft and work the tank down to a horizontal position.

CAUTION

Be sure that all oil, grease and water is wiped from the soles of the shoes and cockpit sills so that injuries from slipping will be avoided.

10. The man straddling the tank can now start the tank backward into the fuselage through station 5 bulkhead.

DEMO dimensione ota

11. The man straddling the tank should now move down onto the wing and with the other man on the opposite side of the cockpit, work the tank back into the fuselage until there is room in the cockpit for one man. One man should now station himself in the cockpit facing the tank while the other man crawls through the fuselage access door and, by working over the center radio shelf, raises the tank to clear the pad on station 7 bulkhead while the man in the cockpit pushes the tank into the fuselage until it rests in its cradle. The man in the fuselage should guide the aft strap between the retaining lugs on the aft end of the tank.

12. While the man is in the fuselage he should fasten the rear tie-down strap at its turnbuckle, take the turnbuckle up and lockwire it. Connect the rear vent line to the fitting on top of the tank and tighten the clamp. Connect the two vent lines at the hose fittings aft of the tank and connect the fuel outlet line to the sump fitting at the bottom rear of the tank.

13. The man in the cockpit should connect the front strap and take up the turnbuckle. Then connect the front tie-down strap and take up on the turnbuckle. Lockwire all turnbuckle bolts.

Note

The fuselage tank should be centered in the cradle so that the turnbuckles on the front and the rear tank straps can be taken up equally.

14. Insert the short pipe elbow in the front vent line connection and connect the other end to the tank vent fitting. Tighten the two clamps.

15. Connect the electric conduit at the gage transmitter.

16. Place a clamp over the filler neck and install the filler neck on the adapter on the tank. Slip the clamp down over the adapter and tighten to secure the filler neck on the tank adapter.

Note

A new filler neck will have to be trimmed on a bevel so that it will fit the filler neck adapter on the tank properly.

17. Connect the two bonding braids, one at the filler neck and one at the fuel gage transmitter.

18. Return the landing gear control handle to "OFF" position.

19. Install the gun sight.

20. Install the canopy control crank on the right side of the cockpit.

21. Replace the handle on the hand hydraulic pump.

22. Install the flight control stick and push-pull tube assembly.

23. Install the station 5 armor plate.

24. Install the pilot's seat.

25. Install the pilot's head rest.

26. Install the oxygen cylinders above the fuselage tank at station 6.

27. Be sure the fuselage tank sump drain cock is closed and safety wired and that the supply line is properly connected.

28. Install the rear keel fairing.

29. On airplanes AF42-104829 and subsequent, re-install the plate on the rear deck. Re-install the rear vision installation and the cockpit canopy.

(3) FUEL LINES.—See section VIII for Fuel System Tubing Diagram and Tubing Chart. All fuel lines are gun-fire protected, self-sealing tubes. These self-sealing fuel lines are made up of a seamless compound inner tube, layers of self-sealing material, plies of reinforcement, and a compound cover. The fuel lines will seal completely within two minutes after firing at a temperature of —4° to +38°C (25° to 100°F), and will seal within four minutes after firing at a temperature of —29°C (—20°F). Clamps for aromatic resistant self-sealing hose will be tightened by adjusting the clamp to finger tightness, then applying 2 to 2-1/2 turns. After installation, hose clamps will be inspected daily for proper tightness until the hose ceases to "cold-flow" and the hose clamp remains tight. (See figures 196 and 197.)

WARNING

Be sure that all layers of material in the self-sealing hose are firmly sealed together. After installation, be sure that the proper number of layers of material are showing beyond the clamp. Any discrepancy here will require immediate investigation, as a layer of material may have been pushed into the hose when it was installed on the tube connection, thus closing the fuel passage.

(4) FUEL SYSTEM PUMPS.—Fuel is pumped from the tanks to the injection type Stromberg Bendix carburetor by a type G-9 engine-driven fuel pump. An electric fuel pump is incorporated in the suction line between the engine-driven fuel pump and the fuel cock. The electric pump (figure 207) consists of an integral explosion-proof electric motor and a small centrifugal type pump. This electric pump does not replace the engine-driven pump, but it is used in conjunction with it. The electric fuel pump switch should be "ON" for all engine operations. The electric fuel pump is controlled by a switch on the left hand side of the main switch panel and has two positions, "ON" and "OFF".

Note

When the Stromberg Bendix carburetor is first used after installation, or has been drained, this procedure should be followed: Open the fuel cock and set the mixture control at "AUTOMATIC RICH" and the throttle half open. Switch on the electric fuel pump and allow the electric pump to operate until a small amount of fuel runs from the supercharger drain. A special condition exists when the carburetor is partly filled with air.

DEMO dimensionriolotta

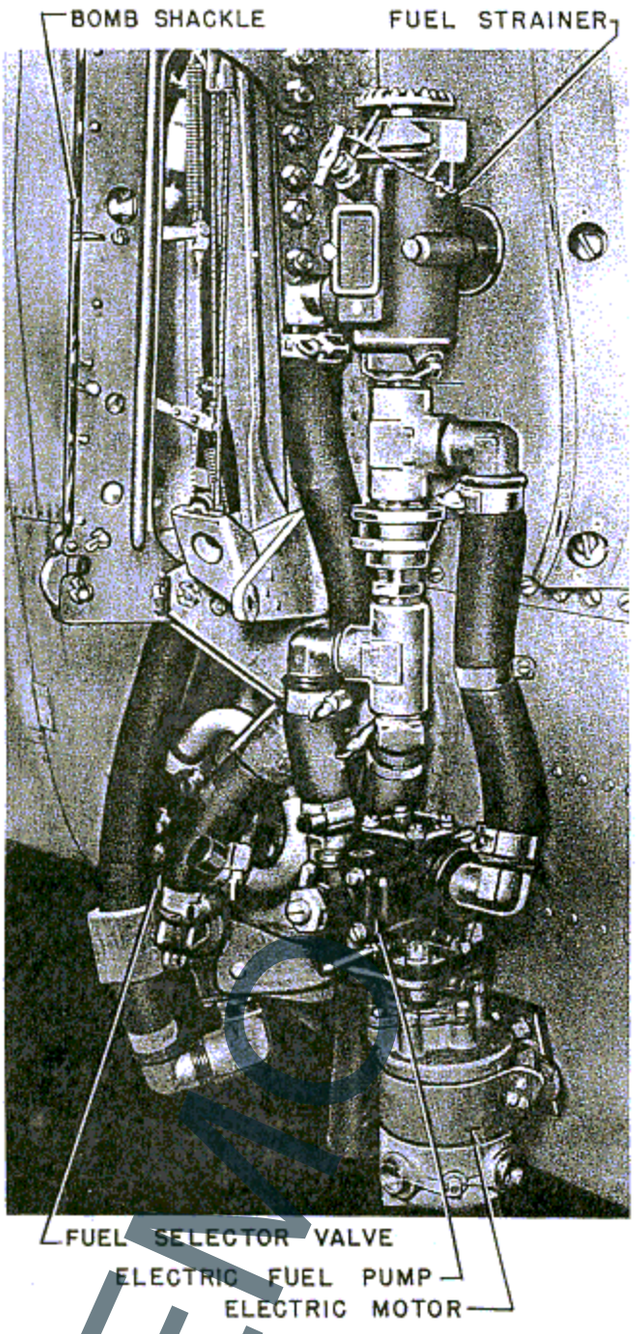


Figure 207—Electric Pump, Strainer, and Selector Valve Installation

The rate at which the fuel may enter the second "regulator chamber" and the "fuel control body" is held to idling rate, causing the carburetor to fill slowly. Since there are no vents in the system beyond the "second regulator chamber", all imprisoned air must escape through the nozzles causing the engine to stop after being started. To eliminate this condition, remove the vent plug from the "second regulator chamber" and operate the electric fuel pump until the fuel is level with the plug opening. Replace the plug. One minute is the usual elapsed time for filling of the carburetor.

(5) FUEL SELECTOR VALVE. *(See figure 208.)* —The fuel selector valve is mounted on a support on the wing match angle.

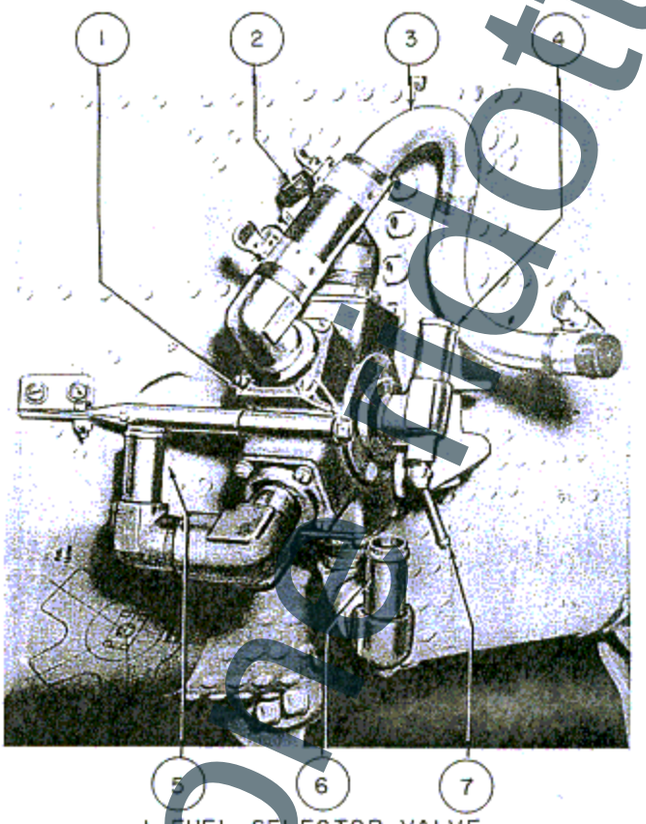


Figure 208—Fuel Selector Valve

(6) PRIMER.—The engine primer system consists of a supply line from the fuel selector valve to the primer, and a line from the primer to the engine intake manifolds. The priming system on the engine is independent of the carburetor and pumping the carburetor throttle will not discharge fuel into the engine.

DEMO dimensioneGotta

(7) FUEL LEVEL GAGES.

(a) FUSELAGE TANK EQUIPMENT.—The fuselage tank is equipped with General Electric DC Selsyn fuel level equipment consisting of an 8DJ11LAT model indicator (weight 0.355 pound) and an 8TJ13LAH model transmitter (weight 1.2 pound). This 24-volt equipment is adapted to the basic operating system, known as the three-wire system, which requires the use of three leads to connect the transmitter to the indicator. (See figures 209 and 260.)

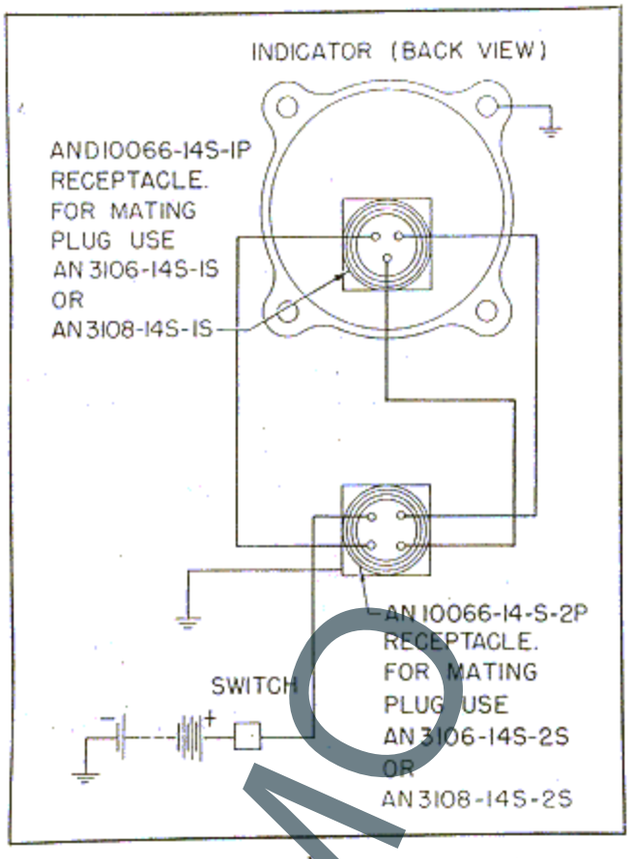


Figure 209—Fuel Level Gage Wiring Diagram

1. TO INSTALL THE INDICATOR.

a. Place the indicator in the instrument panel from the back in the position drilled for it on the left side.

b. Line up the four indicator mounting lugs with the holes drilled in the panel and secure with No. 6-32 screws. Self-locking nuts are provided on the instrument.

c. Attach wires as shown on the wiring diagram (figure 209).

2. TO INSTALL THE TRANSMITTER. *(See figure 210.)*

a. Before inserting the transmitter into the opening provided in the forward end of the fuselage tank, be sure that the tank is empty and that the

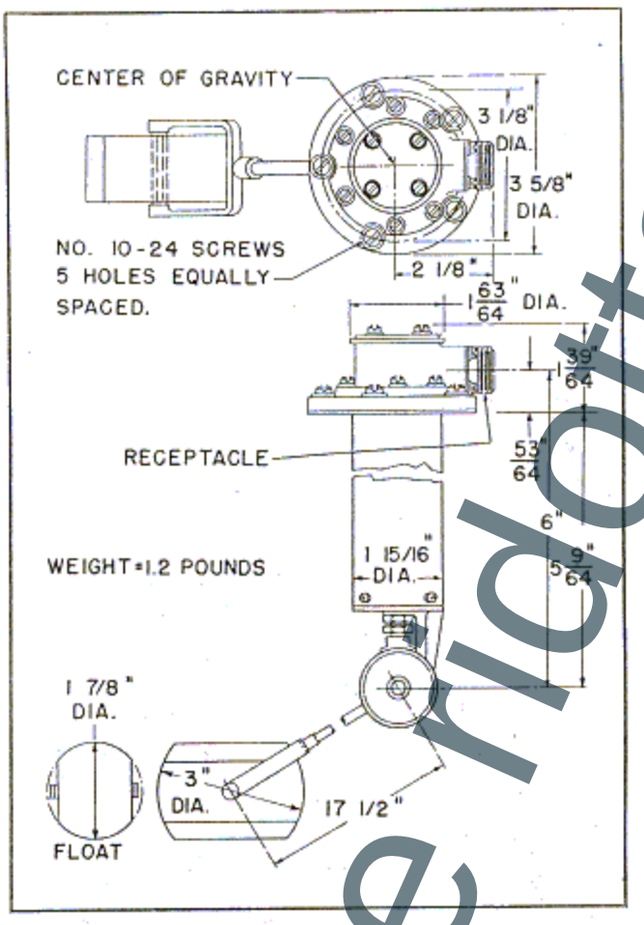


Figure 210—Fuel Level Gage Transmitter

float or float arm does not strike any baffle in the tank.

b. Insert the transmitter in the tank opening with the receptacle located 135 degrees clockwise from the bearing bracket, and secure with No. 10-24 screws through the five equally spaced holes in the transmitter flange. It is now necessary to make the adjustment for empty tank condition.

3. ADJUSTMENT WITH THE FUEL TANK EMPTY.

a. Be sure the tank is empty so that the float will rest on the bottom of the fuel tank.

b. Connect the transmitter and the indicator in accordance with the external connection diagram, figure 209.

c. Loosen the four screws on top of the transmitting element assembly and rotate the adjusting disc until the pointer reads zero. Tighten the four screws. Attach external wires as shown on figure 209.

(b) WING TANK GAGES.—The wing tanks are equipped with float-type sight-gages mounted in the top of the tanks with the dial heads protruding from the floor of the cockpit.

DEMO
dimensione ridotta

(8) SCUPPER DRAINS.—The wing tank scuppers in the left wing fillet are provided with drain lines passing downward through the lower wing skin just to the left of the tank door.

(9) STRAINERS AND TANK DRAINS.

(a) In the bottom of each tank is a sump fitting in which is installed the tank finger strainer, fuel line outlet, and drain plug. All drain plugs incorporate a drain cock for the removal of water. The drain plug in installed directly in the sump fitting in the wing and belly tanks and a remote drain is provided for the fuselage tank. The tank sumps are designed to permit the settling of water to the sump and the removal of this water from the sump without draining the entire tank. Access to the wing tank sumps and drains is through doors in the keel fairing. The drain assembly for the fuselage tanks is under the fuselage to the right of the keel fairing and aft of the trailing edge of the wing, and is accessible through a door in the keel fairing. The belly tank drain and sump are located in the bottom of the tank.

(b) Besides the finger strainers in each tank, there is a strainer in the main fuel line between the fuel selector valve and the electric fuel pump. Access to this strainer is gained through a door on the bottom of the exit duct aft of the cowl flaps. There is also a strainer in the carburetor near the leading edge and is controlled by a rod through the leading edge to a gear box on the forward left side of the firewall. Another control rod runs from the gear box through the firewall into the cockpit to the indicator plate handle. When the engine is not running, a decided "click" can be heard when the indicating plate is engaged. When the engine is running, this engagement can be felt through the control handle. It is mandatory that the fuel selector valve settings be determined by this "click" or "feel" method and not solely by the position of the control handle pointer in the cockpit. If this precaution is not taken, fuel may flow between tanks, creating a very dangerous condition. Inability to hear the "click" or "feel" the engagement is usually caused by excessive drag in the fuel valve or by interference of the rods with other parts. Whenever this condition occurs, the control linkage will be disconnected at the fuel selector valve yoke and both the control linkage and fuel selector valve assembly will be checked for freedom of movement. Drag in the fuel selector valve assembly can be determined by turning the selector valve stem yoke with the fingers.

CAUTION

Whenever fuel selector valve controls are disconnected or fuel selector valve assemblies are removed or replaced, the reassembly of parts must be carefully checked to insure that the valve ports open to the tank positions indicated by the control handle pointer.

7. FIXED EQUIPMENT GROUP.

a. INSTRUMENTS.—The instrument board is mounted on two supports at the bottom and braced by two rods at the top which are attached to the front armor plate. The supports and braces are mounted on bushings. The support bushings are 150P20 (monel) and are installed with the load-rated sides toward each other. Replacement of these bushings and washers should coincide exactly with the original installation.

LIST OF INSTRUMENTS

Instrument	*Type*	*Specification*
Air speed indicator	F-2	94-27335
Altimeter	AN5760-3	AN-GG-A-461
Carburetor air temperature	AN5790-6	AN-GG-I-522
Clock	A-11	94-27970
Compass	B-16	94-27807
Coolant temperature thermometer	AN5790-6	AN-GG-I-522
Engine gage unit	B-7	94-27943
Fuel quantity gage	8DJ71LAT	General Electric
Manifold pressure gage	AN5770-1	AN-G-9
Rate of climb indicator	AN5825-2	AN-GG-I-518
Tachometer	C-11	94-27353
Turn and bank indicator	C-1	94-27337

b. SURFACE CONTROLS.

(1) AILERON CONTROLS. *(See figure 211.)*

(a) DESCRIPTION.

1. The control stick and aileron control torque tube are supported as a unit by two bearings bolted to the wing match angle. Each aileron system has an adjustable link connected to an arm on the control stick torque shaft extending down through the wing to a bellcrank. Cables equipped with turnbuckles for adjustment, run aft from the bellcrank to pulleys and then outboard to a drum which operates the aileron through an eccentric arm.

2. The movement of the stick, for full aileron travel in either direction from its neutral position, is 20-1/2 degrees on either side from the center line of the airplane.

3. The specified tension of the aileron cable is 110 pounds when the ambient temperature is 21°C (70°F).

4. The stops for the aileron control system are bolts through the arms on the aft end of the torque shaft.

(b) ADJUSTMENTS AND RIGGING.

1. Ailerons will be rigged with 1 2 inch maximum droop, measured at the inboard trailing edge of the aileron, with the controls in neutral position.

2. Turnbuckles on the cables are accessible through the inboard trailing edge of the wing when the flaps are lowered.

3. Adjustments on the links are located above the upper wing skin at the aft end of the control torque shaft.

DEMO dimensione ridotta

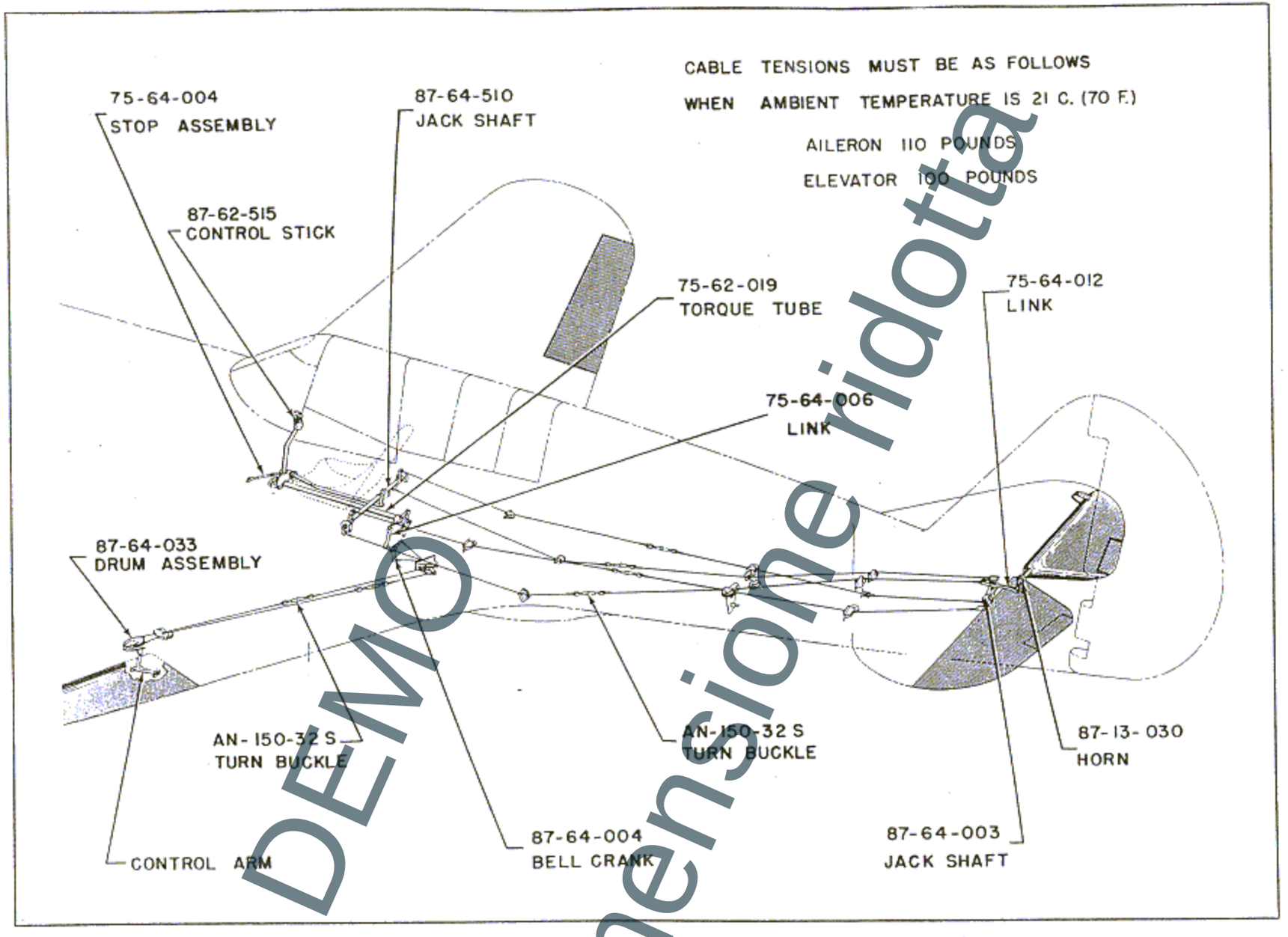


Figure 211—Aileron and Elevator Controls

DEMO dimensione ridotta

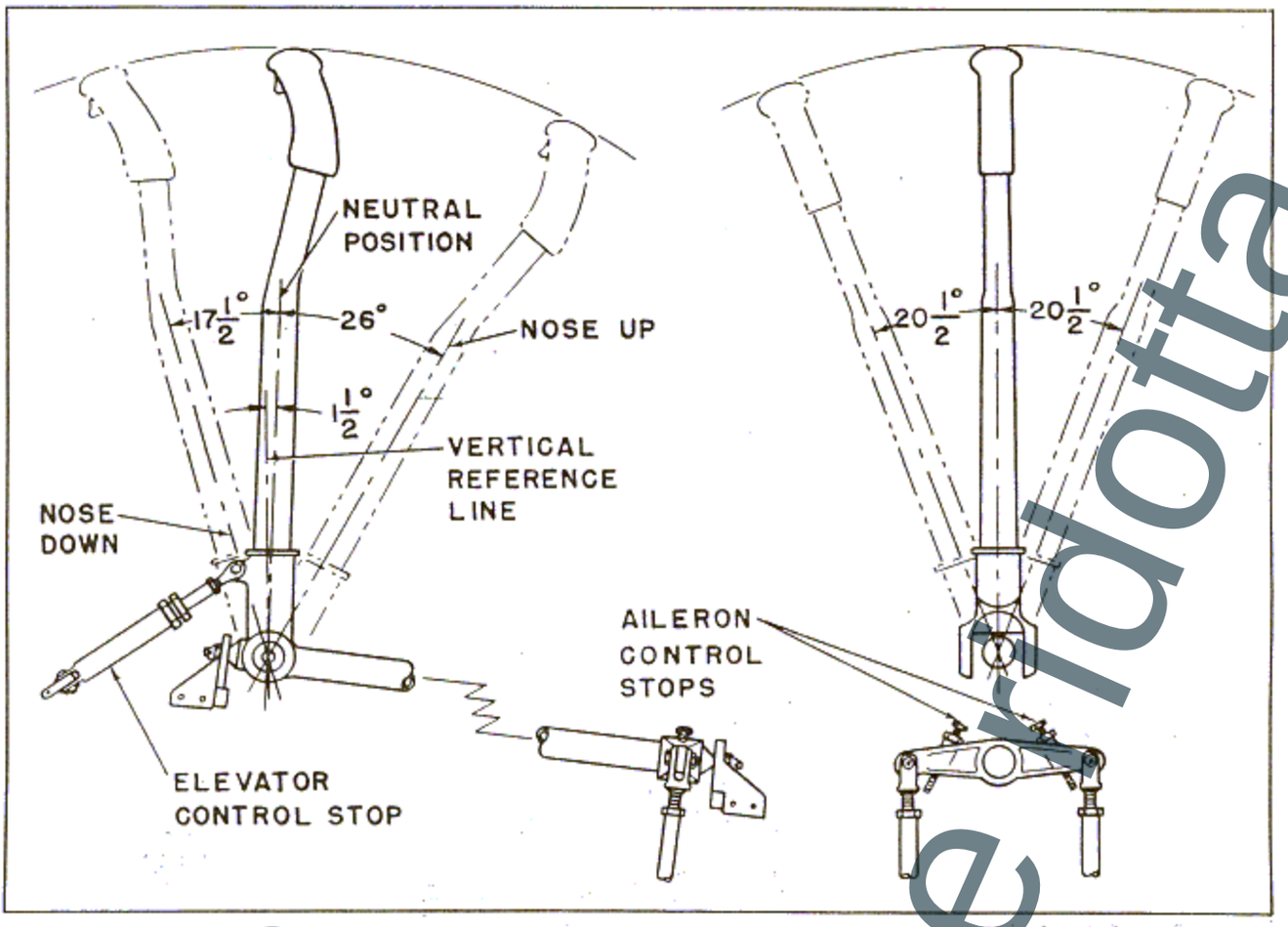


Figure 212—Control Stick Setting

(2) ELEVATOR CONTROLS. *(See figure 211.)*

(a) DESCRIPTION.

1. The stick is connected to the elevator controls by a push-pull tube to a lever on the front jackshaft at station 5. Bellcranks on the jackshaft are connected by two pairs of cables, equipped with turnbuckles for adjustment, to bellcranks on a rear jackshaft at station 16. The cables are crossed between front and rear jackshafts. From the bellcranks on the rear jack-shaft, a single short push-pull link connects to the elevator horn.

2. The stop for the elevator control system is an adjustable cylinder and piston unit attached to the front of the control stick, and leading forward and down to attach to the wing match angle.

3. The specified tension of the elevator cables is 100 pounds when the ambient temperature is 21°C (70°F).

(b) TO REMOVE FRONT JACKSHAFT.—To remove the forward jackshaft, disconnect the push-pull tube from its arm and the four cables from the horns. Remove the eight bolts attaching the three bearing supports to the bulkhead and remove the shaft and bearing supports. The bearing supports may then be detached if desired by removing the nuts at the end of the shaft.

(c) TO REMOVE REAR JACKSHAFT.—The rear jackshaft may be removed by disconnecting the cables and link, and then removing the four bolts which attach the bearings to their supports.

(d) TO INSTALL FRONT JACKSHAFT.—Assemble the bearing supports on the torque shaft and install the retaining nuts on the shaft ends. Attach the jackshaft assembly to the bulkhead at station 5 by the eight bolts through the three bearing supports. Connect the flight control stick push-pull tube to the jackshaft arm and connect the four control cables to the horns.

(e) TO INSTALL THE REAR JACKSHAFT.—Install the four bolts which attach the bearings to their supports and connect the cables and the elevator link to the jackshaft horns.

(f) ADJUSTMENT.—The turnbuckles for adjusting the tension in the elevator control cables are accessible through the fuselage access door. To adjust the elevator throws and cable tension proceed as follows: Set the front jackshaft in neutral position (cen-

DEMO dimensionedrafta

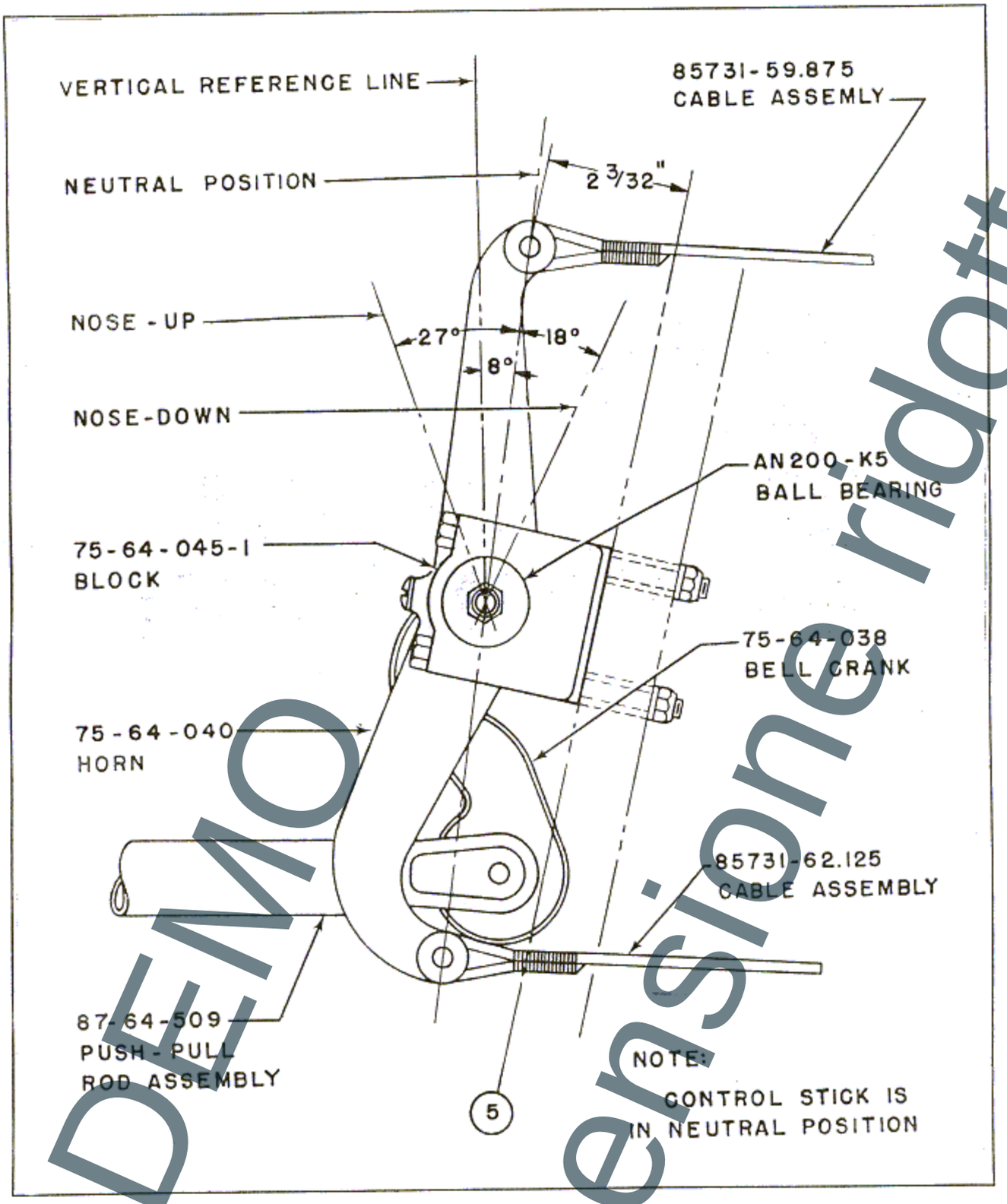


Figure 213—Jackshaft Setting

DEMO dimensione ridotta

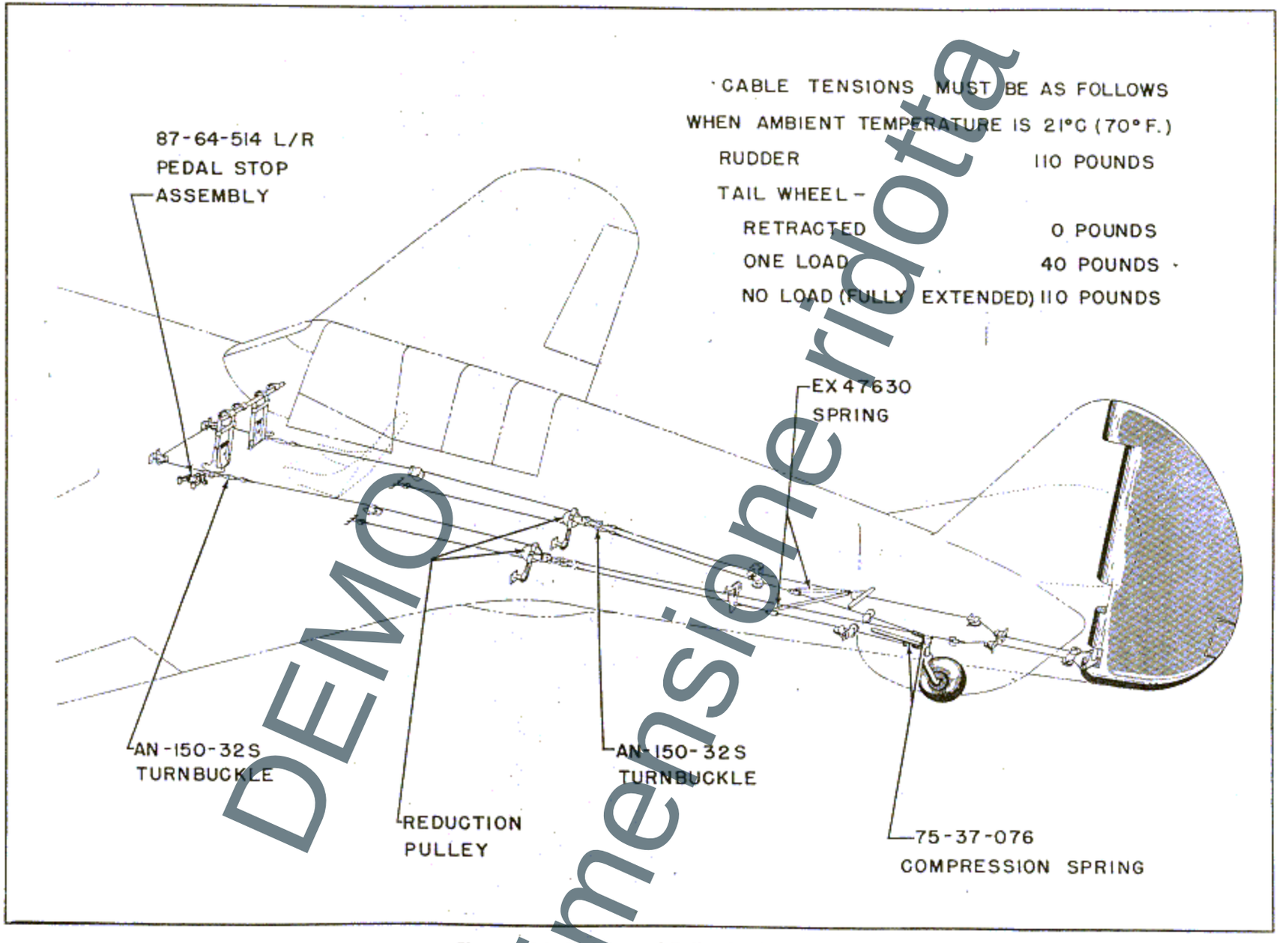


Figure 214—Rudder and Tail Wheel Controls

DEMO dimensione ridotta

ter line of top hole in jackshaft horn at 2-3/32 inches from the bulkhead). (See figure 213.) Adjust the cable turnbuckles until the elevator surfaces are in neutral and then using a tensiometer (figure 215) adjust turnbuckles to obtain 100 pounds tension in the cables when the surrounding temperature is 21°C (70°F). Adjust the elevator movement by adjusting the stop on the forward side of the flight control stick. (See figure 212.) The range of movement of the elevators should be 30 degrees up and 20 degrees down from the streamline with the stabilizer. The permissible tolerance is ± 2 degrees.

(3) RUDDER AND TAIL WHEEL CONTROLS. *(See figure 214.)*

(a) DESCRIPTION.

1. The rudder control system is operated by two cables running aft from the rudder pedals. Each cable passes around a reduction pulley mounted on an arm at station 8. Two cables attached to each reduction pulley by turnbuckles, lead aft, one connecting to the rudder horn, the other to the tail wheel horn. These move in unison for steering the airplane on the ground. A run-around cable runs from one pedal forward around two pulleys to the opposite pedal.

2. Each tail wheel control cable passes through a pair of guide pulleys at station 13. Slack in the cable is avoided by the use of two coil tension springs attached to the lift tube at the center line of the fuselage and to the cable at station 12. The cable also incorporates a compression spring to avoid transmitting taxiing shock to the rudder pedals.

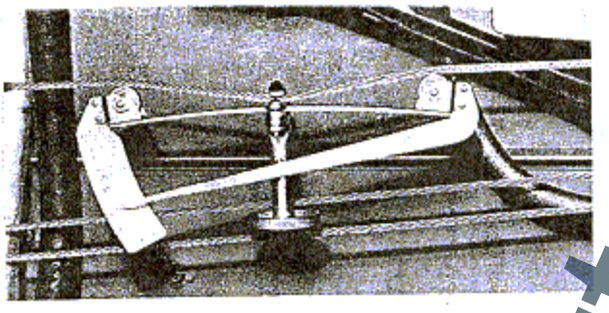
3. The rudder pedal stops are small castings mounted on the fuselage-wing attachment angle, one on each side of the cockpit near the floor. The rudder pedal in the full forward position strikes the adjustable stop screw head. There is also a horn stop assembly installed on the lower rudder hinge block in AF43-24253 and subsequent airplanes. (See figure 106.) The horn stop assembly prevents the rudder from exceeding its normal range of travel when loads are imposed that stretch the rudder cables.

4. The specified tension of the rudder and tail wheel cables is as follows when the ambient temperature is 21°C (70°F):

Rudder Cables	110 pounds
Tail Wheel Cables (retracted)	0 pounds
Tail Wheel Cables (one load)	40 pounds
Tail Wheel Cables (no load)	110 pounds

All cables requiring specified tension are tested for correct loading by a tensiometer. (See figure 215.)

(b) ADJUSTMENT.—The turnbuckles for adjusting the tension in the rudder and tail wheel control cables are located just aft of station 8 and are accessible through the fuselage access door. Other adjustment is obtained at the turnbuckles which are installed in the cables at the rudder pedals. To adjust the rudder throws and cable tensions, proceed as follows:



CABLES MUST BE RIGGED TO FOLLOWING TENSIONS, WHEN THE AMBIENT TEMPRATURE IS 21°C (70°F)

AILERON	110 POUNDS
ELEVATOR	100 POUNDS
RUDDER	110 POUNDS
TAIL WHEEL	
RETRACTED	0 POUNDS
ONE LOAD	40 POUNDS
NO LOAD (FULLY EXTENDED)	110 POUNDS

Figure 215—Use of Cable Tensiometer

1. Hold the rudder pedals in neutral position by clamping the two pedals to a straight metal bar.

2. Adjust the two turnbuckles in the rudder control cables at station 8 so that the rudder is in neutral position (in streamline with fin.)

3. Adjust the turnbuckles at the rudder pedals and at the reduction pulleys to obtain a tension of 110 pounds in both, rudder and tail wheel cables, when the surrounding temperature is 21°C (70°F).

Note

Jack the aft end of the airplane so that the tail wheel will be fully extended when adjusting the rudder cable tension to 110 pounds.

4. Unclamp the rudder pedals from the metal bar and adjust the rudder throws by adjusting the pedal stops which are located forward of each pedal. The range of movement of the rudder is 30 degrees either side from the streamline with the fin. The permissible tolerance is ± 2 degrees.

Note

On those airplanes having the rudder horn stop installed, back off the bumpers so that the adjustment of the stops forward of the rudder pedals can be made accurately; then, adjust the bumpers of the horn stop assembly to permit full rudder movement.

5. Push each rudder pedal to the extreme forward position and check the clearance between the reduction pulley and the bulkhead at station 8. The reduction pulley should clear the bulkhead by at least 1/2 inch. If this clearance is not obtained, readjust the turnbuckles to obtain it.

DEMO dimensione rigotta

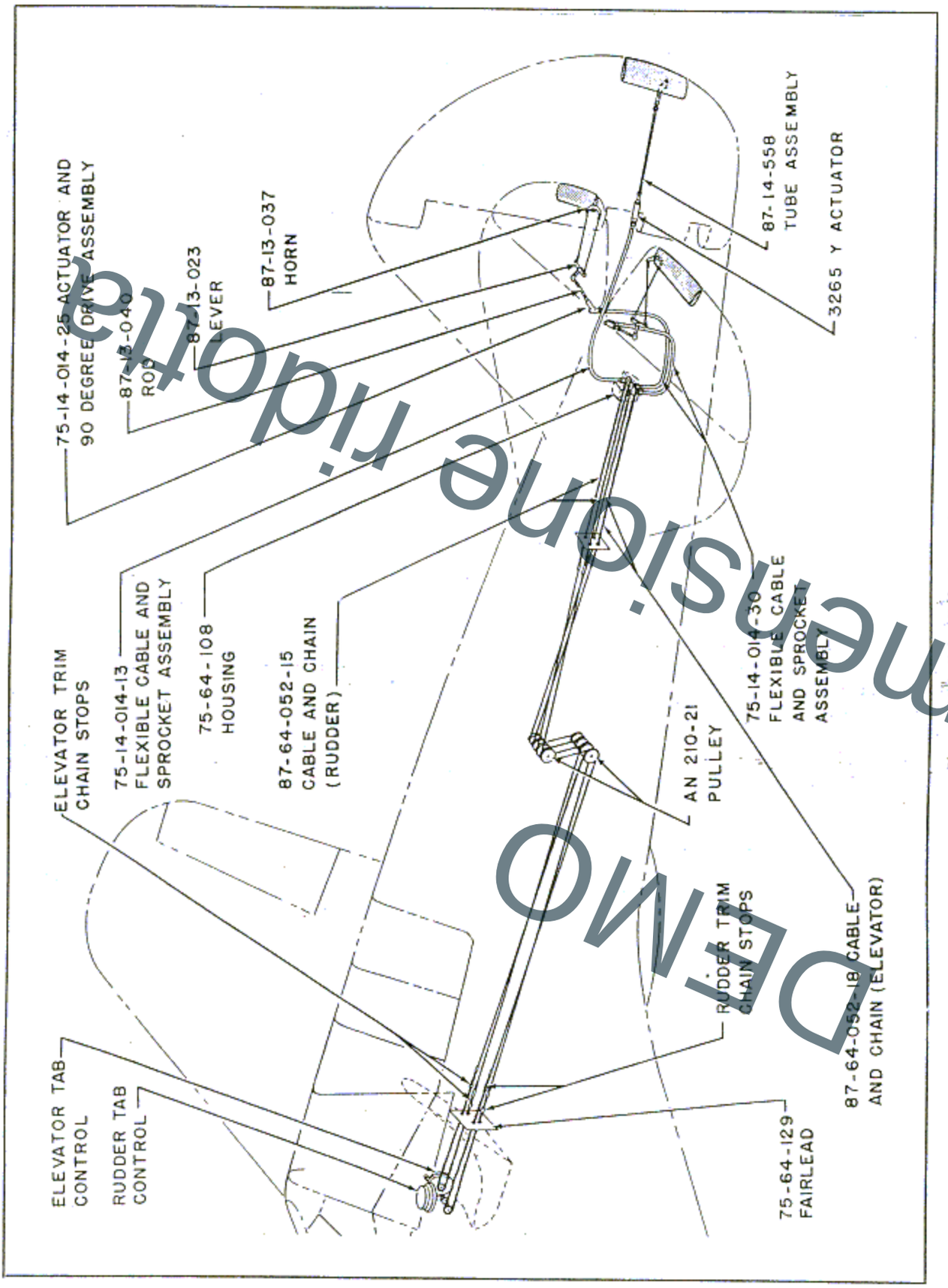


Figure 216—Trim Tab Controls

DEMO dimensione rifonda

(4) TRIM TAB CONTROLS.

(a) AILERON TRIM TABS. — Airplanes AF42-104429 through AF43-24251 are equipped with fixed aileron trim tabs of metal which must be adjusted while the airplane is on the ground. Merely bend them up or down as desired. They are attached to the inboard trailing edge of each aileron.

Note

Airplane AF43-24252 and subsequent, are equipped with an electrically operated trim tab in addition to the fixed trim tabs. The electric aileron trim tab, located on the left hand aileron, inboard of the fixed trim tab, is controlled by means of an electric motor mounted in the leading edge of the aileron. The momentary contact operating switch for the motor is located aft of the engine control quadrant and just forward of the rudder trim tab control.

(b) ELEVATOR AND RUDDER TRIM TABS.

1. DESCRIPTION.—The elevator and rudder trim tab controls are mounted on the left side of the cockpit. Motion is transmitted by a chain and sprocket drive to the gear-box mounted just forward of the rear elevator jackshaft. The control chain is equipped with turnbuckles for adjustment. From the gear-box, three flexible shafts, two for the elevator and one for the rudder, transmit motion, one to each tab control actuator unit. Short tie rods connect these actuators to the elevator tabs; a longer rod, enclosed in a fairing on the right side of the rudder, connects with the rudder tab.

2. ADJUSTMENT.

a. Control chain tension is adjustable by turnbuckles accessible through the baggage compartment door.

b. In the assembly of the rudder trim tab actuating arm, 7/8 ±1/32 inch is allowed between the end of the actuator screw jack and the end of the tube. The lock nut is tightened against the actuator, and the actuator and tube are jointly drilled and cottered. The actuator is extended 3-5/8 ± 1/32 inches (measured from the center of the hinge pin holes to the end of the actuator screw jack), to assure proper throw of the trim tab. The clevis end can be adjusted so that the distance between the hinge pin center on the actuator and the clevis-and-bolt-hole center is approximately 23/32 to 25/32 inch.

c. The rudder tab actuating arm fairing located on the right side of the rudder is removed and the actuating arm assembly is installed. The rudder tab control, located at the left of the pilot's seat is set at 0 degrees before the flexible shaft is attached to the rudder tab actuator.

d. Final adjustment of the trim tab is attained by turning the clevis end of the actuating arm assembly as required to align the trim tab center line with the rudder center line. The lock nut is tightened against the clevis end, and the clevis end and tube are jointly drilled and cotter pinned.

c. HYDRAULIC SYSTEM. *(See figure 217.)*

(1) GENERAL DESCRIPTION.—The main hydraulic system of this airplane operates the retractable alighting gear and the wing flaps. An Eclipse, type 809, model 3, motor-driven hydraulic pump, accessible through the fuselage access door, is the chief source of pressure for the system which must be serviced exclusively with hydraulic fluid, AAF Specification 3586. An auxiliary hand pump located on the right side floor of the cockpit may be used to produce pressure in place of the Eclipse motor. Two main landing gear retracting struts, one tail wheel retracting strut, one flap actuating cylinder, a control or selector valve, three relief valves, a check valve, reserve tank, line tubes and fittings comprise the remaining essential components of the system. Consult Tubing chart of Hydraulic system in section VIII for torque requirements in assembling tubes and fittings.

(2) MOTOR DRIVEN HYDRAULIC PUMP.

(a) GENERAL.

1. The Eclipse pump, type 809, model 3, which builds pressure in the hydraulic system is of spur gear construction, mounted on a 24-volt electric driving motor. The upper spur gear shaft of the pump unit is keyed to the motor armature shaft by a flexible coupling which provides the driving force for the pump. The lower spur gear is meshed with the upper gear and its shaft is retained in the two pump housing sections. The pump housing is of the split type held together by eight bolts and two cap screws. The two pump housings are held in alignment by two dowel pins through the pump flanges. The pump head incorporates an inlet and an outlet port for external tubing connections. A pressure relief valve is also installed in the pump head and provides the means to limit the outlet pressure to 1150 pounds per square inch. An oil seal, installed on the drive end of the upper spur gear shaft, prevents leakage of oil into the electric motor housing from the pump housing.

2. The unit is mounted, by means of a bracket provided on the motor housing. A type B-6B switch, located on the control stick below the grip, controls the operation of the pump. The inlet port is connected to the hydraulic fluid reserve tank. The outlet port is connected to the system supply line.

(b) EXTERNAL INSPECTION FOR MOTOR TROUBLE.

1. If the electric motor (to which the hydraulic motor-driven pump is attached) fails to operate, or operates at too low a speed, the possible cause may be low voltage, due to a discharged battery. Check the battery and recharge if necessary.

2. It may also be due to loose or corroded battery terminals. Clean, tighten, and coat with vaseline.

DEMO dimensionriotta

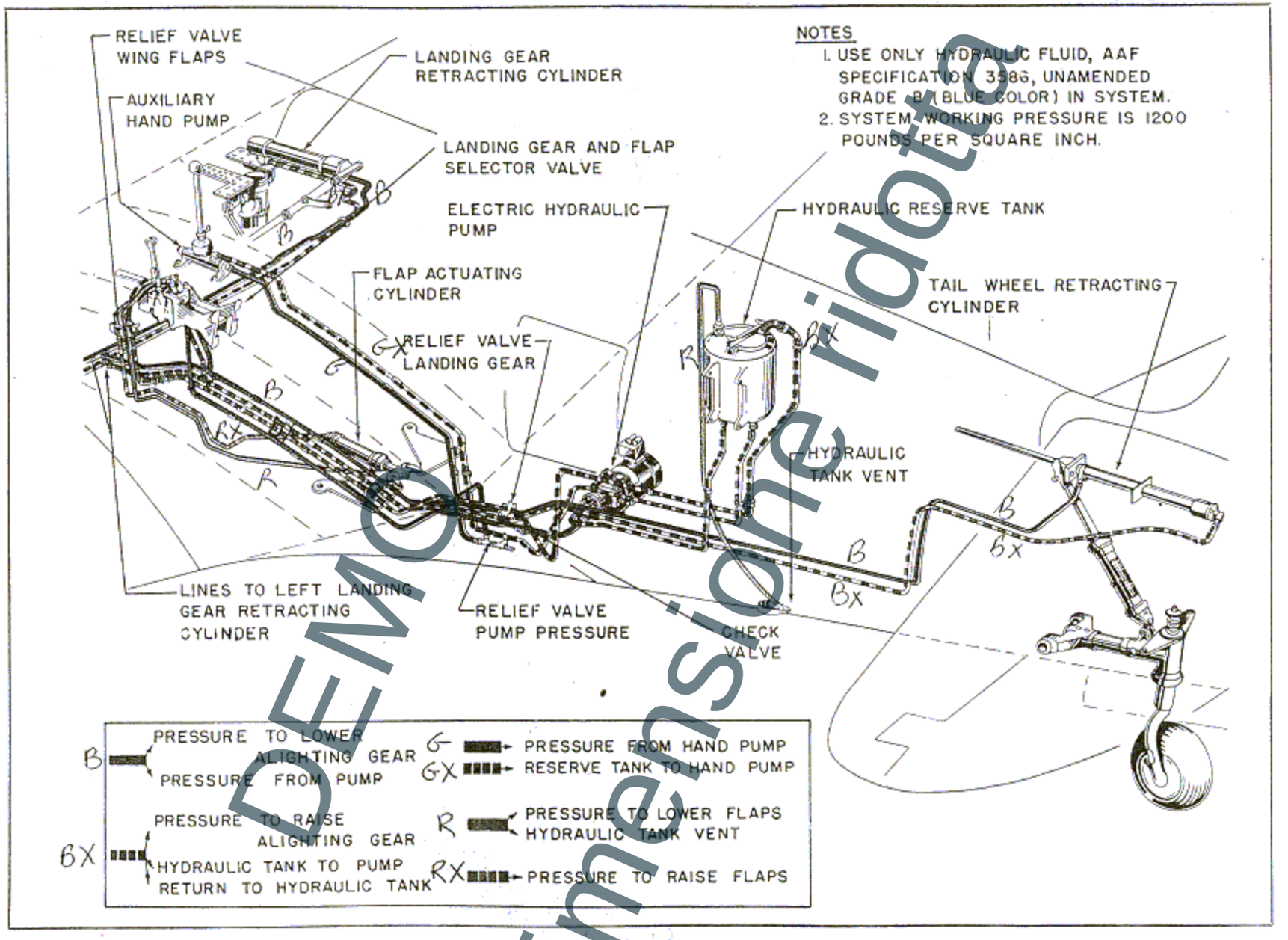


Figure 217—Hydraulic System

DEMO dimensione ridotta

3. If these are not the cause, check the wiring connections for loose or high resistance connections.

4. If the motor shows low output pressure or capacity, check the system for insufficient fluid supply, low setting of the relief valve (installed in the pump head), leak in the line or valves, low operating speed, loose fittings, or improper fluid.

(c) TO DISASSEMBLE THE MOTOR DRIVEN PUMP.

1. Remove the motor and pump assembly from the fuselage by first disconnecting the electric cables from the battery, and the inlet and outlet hydraulic lines from the ports on the pump face. Remove the bolts attaching the base of the motor housing to the fuselage mounting shelf.

2. Place the motor and pump assembly in a vise with aluminum covered jaws as shown in figure 218.

3. Cut the safety wire on the two cap screws on the pump body and remove the screws. Engage the heads of the eight through bolts with a wrench and turn the lock nuts off the inboard side of the pump flange with another wrench. (See figure 218.)

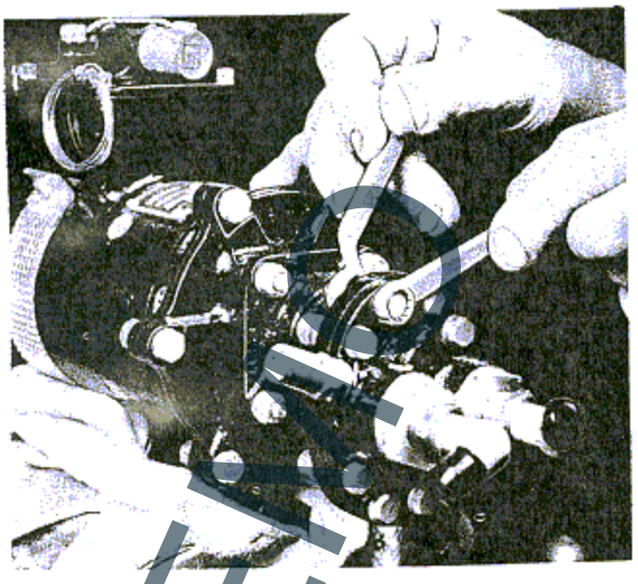


Figure 218—Removing Bolts to Separate Hydraulic Pump Unit

4. Release the pump motor from the vise, turn it to a vertical position, secure again, and tap the two dowel pins from the pump flanges with a punch and light hammer. (See figure 219.)

5. Tap lightly around the port plate with a wooden hammer to separate the pump face from the pump body and pull the spur gears from the pump housing. (See figure 220.)

CAUTION

The spur gears must be handled with extreme care to prevent nicking or scratching. When overhauling more than one pump at a time, keeps the gears in sets for reinstallation in the same pump bodies.

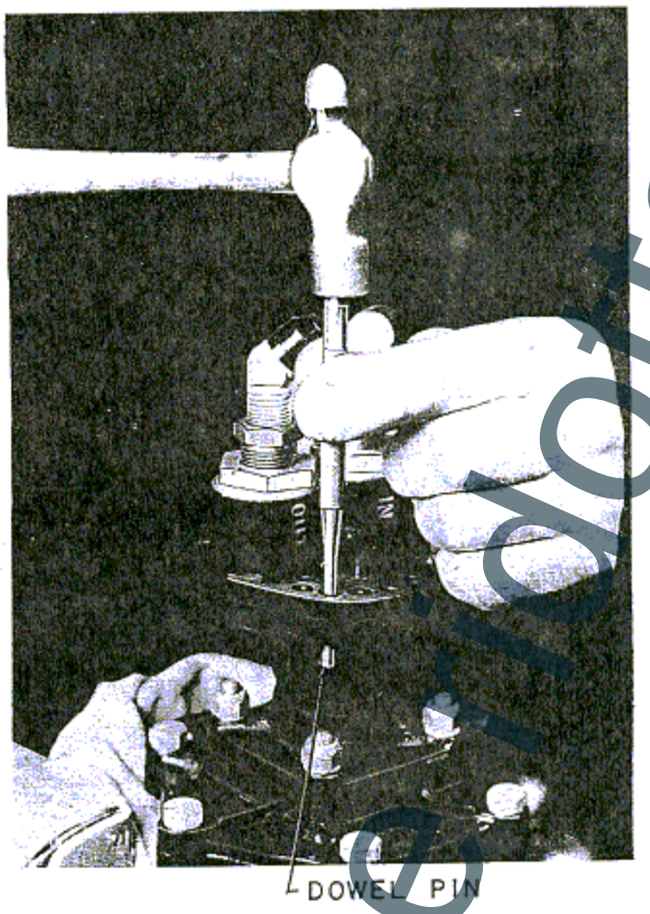


Figure 219—Removing Pins from Pump Housing Flange

6. The pump body can now be separated from the motor housing by removing the four lock nuts around the body flange.

7. Removal of oil seal at the drive end of the pump body is effected by unscrewing the slotted nut in the pump body.

8. Disassembly of the relief valve on the port face of the pump simply requires the removal of the cap and the unscrewing of the relief spring retainer.

(d) INSPECTION FOR REPLACEMENTS.

1. When the pump is disassembled, thoroughly clean all parts with alcohol and examine them carefully for signs of wear and damage, and the presence of foreign matter such as metal chips, grit and dirt. If the spur gears or pump housing are damaged, even slightly, replace with a new pump unit. When foreign matter is found, the complete hydraulic system must be drained and flushed.

(e) TO ASSEMBLE THE MOTOR DRIVEN PUMP.

1. Assemble the relief valve by screwing in the relief spring retainer and installing the cap.

DEFENSE dimensions.com

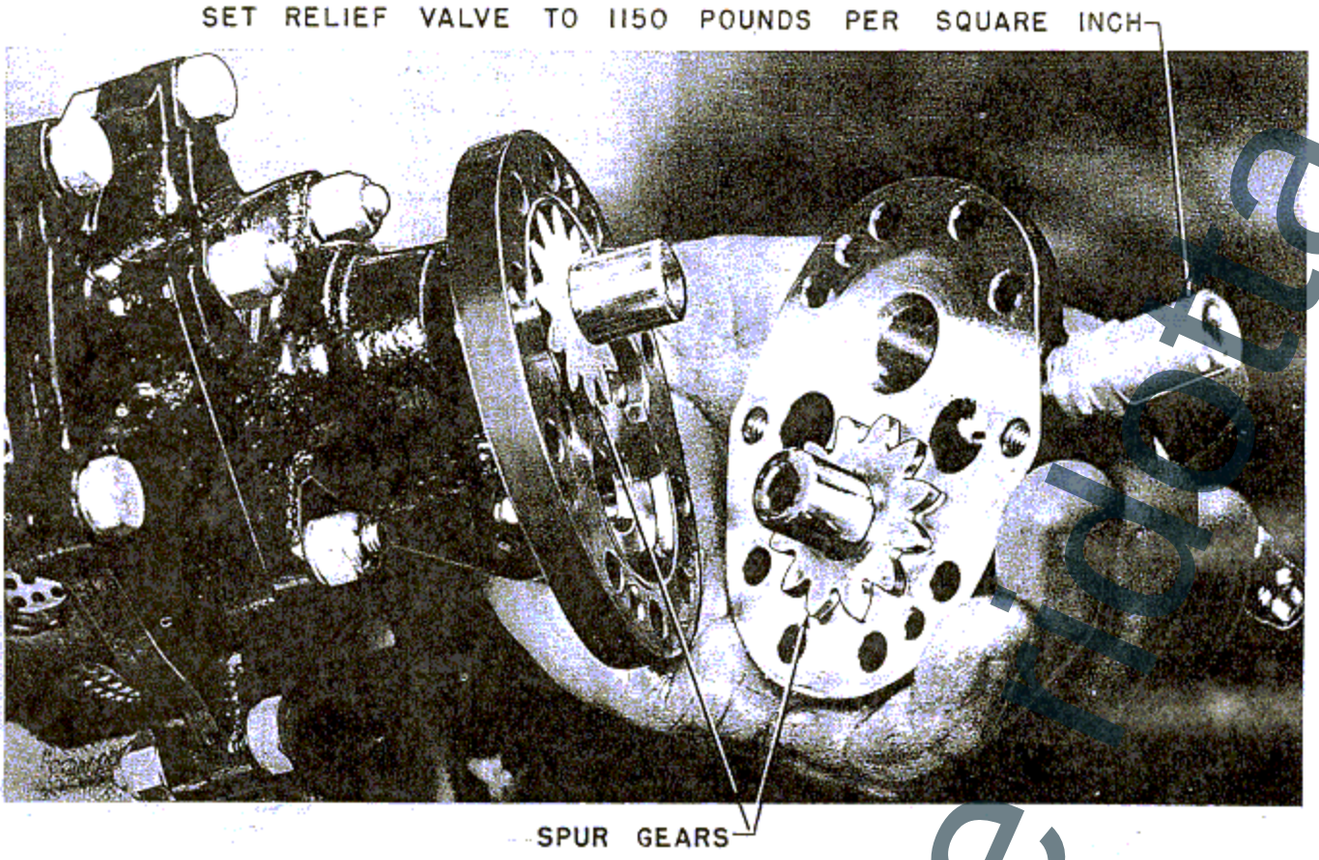


Figure 220—Separating Hydraulic Pump Housing

2. Install the oil seal at the drive end of the pump body by screwing in the slotted nut in the pump body.

3. Secure the motor housing in a vertical position in a vise with aluminum jaws, then after making certain that the machined surfaces are thoroughly clean, attach the pump body to the motor housing by installing the four locking nuts.

4. Reinstall the spur gears, handling carefully to avoid nicking or scratching, making sure where more than one pump is disassembled, that the gears are kept in sets as originally installed, and are returned to the same pump bodies.

5. Attach the pump face to the pump body by first tapping in the dowel pins with a punch and light hammer. Change the assembly in the vise to a horizontal position, then secure the eight through bolts by the use of two wrenches as shown in figure 218, and install the two cap screws and safety with wire.

6. Remove the complete assembly from the vise and bolt the base of the motor housing to the fuselage mounting shelf. Fit the inlet and outlet hydraulic lines to the ports in the pump face, and connect the battery cables.

(3) AUXILIARY HYDRAULIC HAND PUMP.

(a) GENERAL.—The auxiliary hydraulic hand pump, located on the right side of the cockpit is a single cylinder, reciprocating, double action pump, equipped with an intake check and a discharge check valve. This pump provides pressure for the hydraulic system in lieu of the motor-driven pump.

(b) TO DISASSEMBLE THE AUXILIARY HYDRAULIC PUMP.

1. Remove the hand pump from the floor of the cockpit by disconnecting the two hydraulic lines and removing the four hold-down bolts.

2. To facilitate handling of the pump and to protect the cylinder, it is recommended that the cylinder be mounted to a metal table with a perpendicular tee piece for clamping in a vise.

3. With the pump body mounted to a table in a vise, turn the boot inside out and pry off as shown in figure 221.

4. Cut the safety wire on the pump nut and turn the nut from the pump body by the special hand pump wrench (part No. 87-88-032) carried in the airplane tool kit. (See figure 222.) Remove the shim under the nut flange.

DRAWO dimensione Cobia

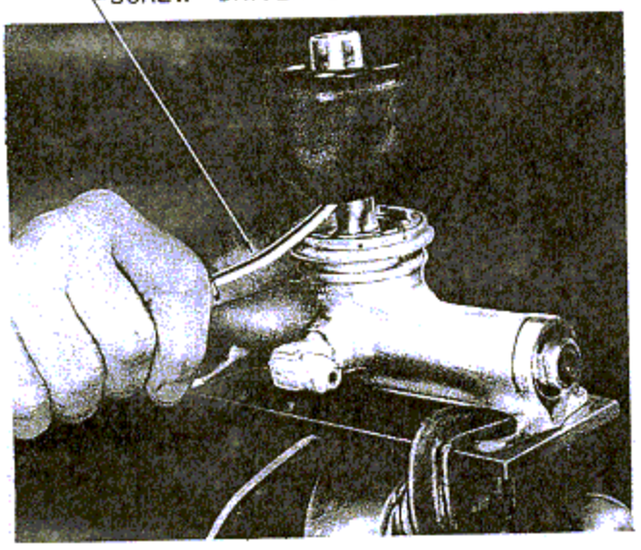


Figure 221—Removing Boot from Hand Pump

5. Pull the ball-piston end out of the pump housing. (See figure 223.) Remove the pump nut packing.

6. Pull the snap rings with a snap-ring wrench and remove the valve assemblies at both ends of the pump cylinder.

7. A screwdriver may be used in either end to push the piston assembly from the pump cylinder. Place the screwdriver in the slot on the retainer when applying force to remove the piston so that the face of the retainer will not be disfigured.

8. The piston and valves may now be disassembled to check the ball and ball seats as well as the springs.

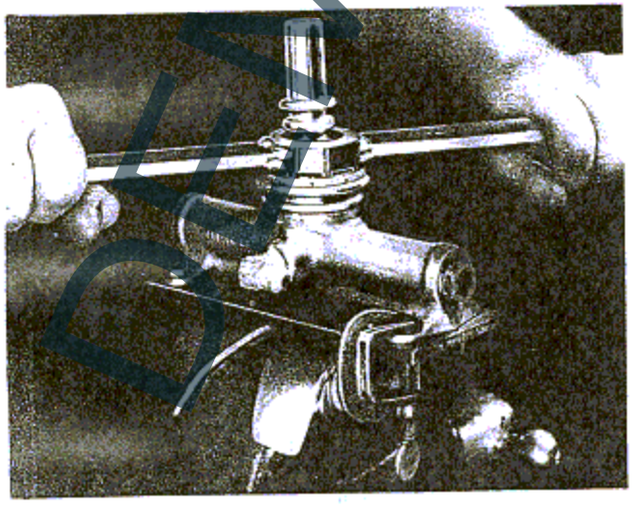


Figure 222—Removing Nut from Hand Pump Body

9. Insert the correct size Allen wrench in a vise in a horizontal position with just enough of the wrench protruding to engage the Allen setscrew in the retainers at either end of the piston.

10. Engage the Allen wrench in the Allen setscrew and apply an adjustable wrench to the piston at its flat sides. Turn the piston with the wrench to loosen the Allen setscrew. Extreme care must be exercised in this operation to avoid breaking the wrench.

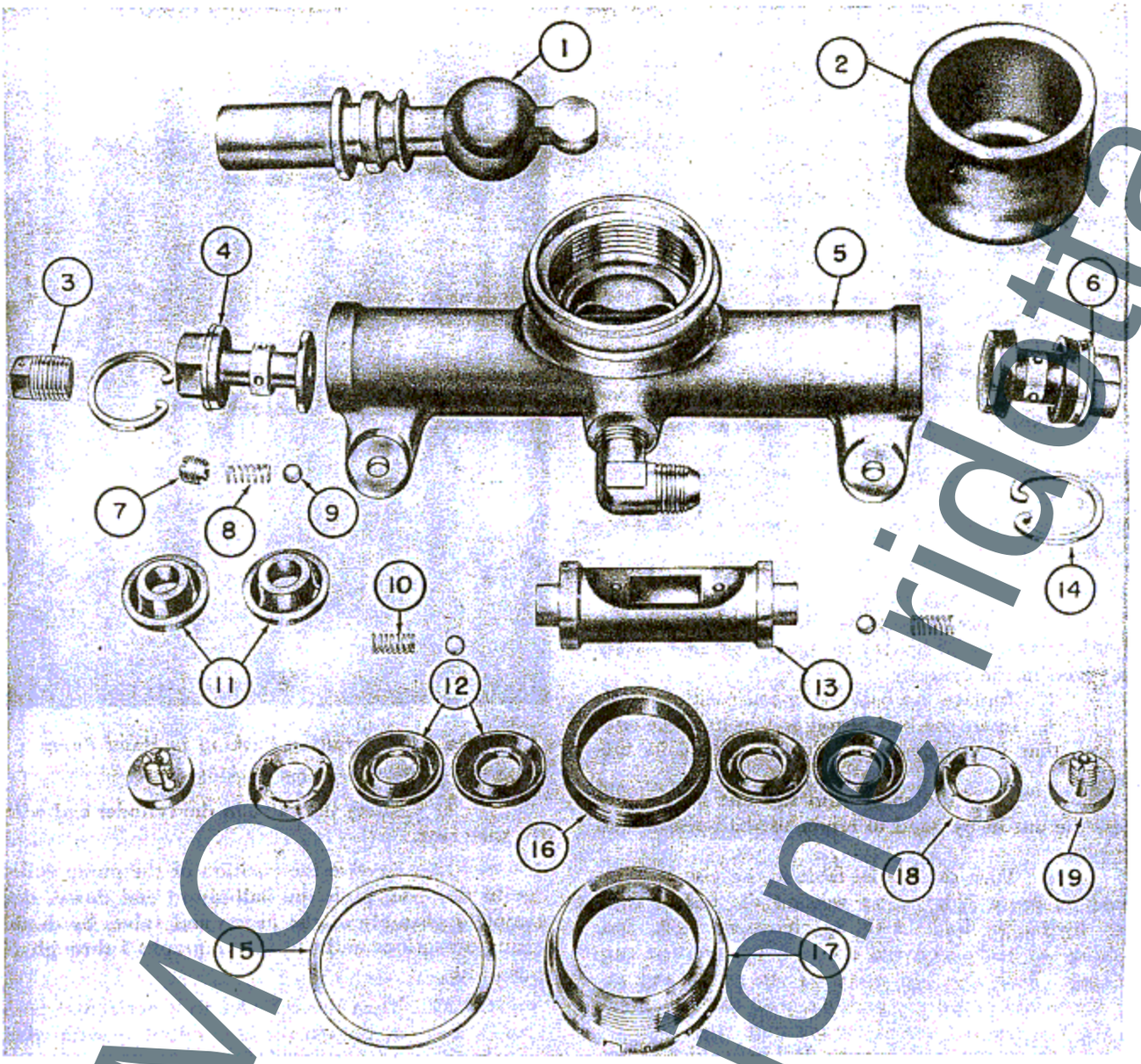
11. When the Allen setscrew has been loosened, pull the piston from the Allen wrench and unscrew the retainer with a screwdriver. This will free the packing ring and packings as well as the spring and hardened steel ball.

12. Reverse the piston and remove the other retainer in the same manner as described in steps *10* and *11*, preceding.

Figure 223—Removing Ball-Piston End from Hand Pump Body

13. In removing the ball and spring in either of the two valves, extreme care must be exercised to avoid damaging the retainer end by twisting off the ears. If a small screwdriver is used for this operation, the retainer is quite often damaged beyond repair; therefore, it is suggested that a special tool be made for this delicate operation. A tool can be made by taking a small size concrete drill and grinding the point down flat so that the four fins on the drill engage the four slots in the retainer. Insert this special tool in a vise in vertical position and slip the valve over the tool until the retainer is engaged properly. Place the adjustable wrench on the flat sides of the valve end and turn the piston until the retainer is loosened. Remove

DEMO
dimensionpdf



1. BALL-PISTON END
2. BOOT
3. PLUG
4. VALVE
5. PUMP BODY
6. VALVE ASSEMBLY
7. RETAINER
8. SPRING
9. HARDENED STEEL BALL
10. SPRING
11. CUP PACKING
12. PACKING
13. PISTON
14. SNAP RING
15. SHIM
16. PACKING
17. NUT
18. PACKING RING
19. RETAINER

Figure 224—Hydraulic Hand Pump Disassembled

DEMO dimensione ridotta

the valve from the special tool and remove the retainer with a small screwdriver. The spring and hardened steel ball will now drop out of the valve.

14. The valve cup packings can now be slipped off the valve. The pump is completely disassembled. (See figure 224.)

(c) INSPECTION FOR MINOR REPAIRS AND REPLACEMENTS.

1. Most pump failures are due to foreign matter lodging in between the steel balls and seats which must lap perfectly in the piston assembly; therefore, inspect those units carefully and be sure they are thoroughly clean before reassembly. When the ball seat is scratched or pitted, try hand lapping to secure a perfect lap fit with the ball. If a perfect fit cannot be effected, replace the entire piston unit.

2. In assembling the rubber packings, for the complete pump assembly, care must be taken not to damage the feather edges, for a slight cut will cause unsatisfactory pump performance and necessitate replacing the packings. Before installing, immerse the packings and coat the parts with hydraulic fluid, AAF Specification 3586.

(d) TO ASSEMBLE THE HYDRAULIC HAND PUMP.

1. Attach the pump body to the special table in a vise as illustrated in figure 225 and install the piston in the cylinder.

2. Replace the ball-piston-end-packing ring.

3. Insert the ball-piston end in its place and be sure that it engages the rectangular slot in the piston.

4. Drop the shim onto the nut flange and screw the nut in by hand to retain the ball-piston end in place.

5. Turn the special table in the vise as illustrated in figure 225. After wetting the piston cups with hydraulic fluid, AAF Specification 3586, and pushing the ball-piston end down, insert the first cup packing. Push this cup down on the piston and insert the second piston cup packing, push this cup down on the first cup and install the packing ring.

6. Insert the hardened steel ball and a spring in the piston end.

7. Place an Allen wrench on the Allen setscrew in the retainer and guide the retainer down into place on the piston. Engage a screwdriver in the slot in the face of the retainer and screw the retainer into place. Tighten the Allen setscrew with the Allen wrench.

8. In assembling either of the two valves at the pump cylinder ends, first slide on the cup packings coated with hydraulic fluid, AAF Specification 3586.

9. Insert the hardened steel ball and spring in the valve.

10. Place the special tool described in paragraph (3), *(b), 13,* preceding, in a vise in a vertical position and engage the retainer. Install the retainer by applying an adjustable wrench to the flat sides of the valve end.

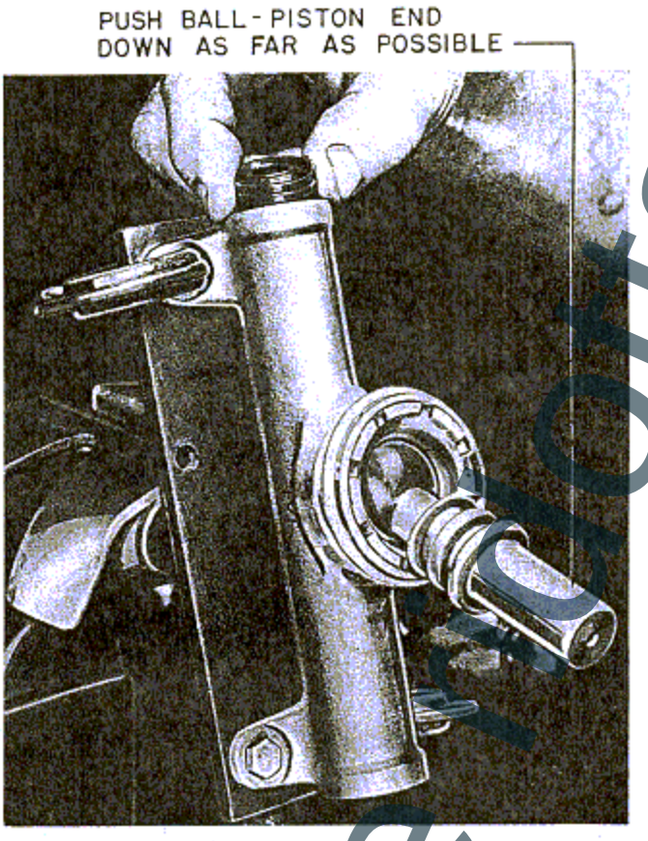


Figure 225—Installing Packing in Hand Pump

11. Safety the valve in the cylinder end with the snap ring.

12. Reverse the position of the pump cylinder in the vise, push the ball-piston end down, and complete assembly of the piston and valves by duplicating operations outlined in paragraphs *5* through *11* preceding.

13. Turn the cylinder to a horizontal position in the vise, tighten the nut and safety with wire.

14. Turn the rubber boot inside out, force the top of the boot over the flange on the ball-piston end, then turn the boot down and stretch its bottom over the flange on the pump body.

(e) TEST.

1. Before installing the auxiliary hand pump, test it in accordance with the procedure outlined on figure 226.

(4) HYDRAULIC CONTROL VALVE. *(See figure 227.)*

(a) GENERAL.—The hydraulic control (or selector) valve for the retracting and lowering of the alighting gear and wing flaps, is located on a mounting bracket at the left side of the cockpit just forward of station 5 bulkhead. This control valve meters the flow of pressurized hydraulic fluid through a series of

DRMO dimensione Cuba

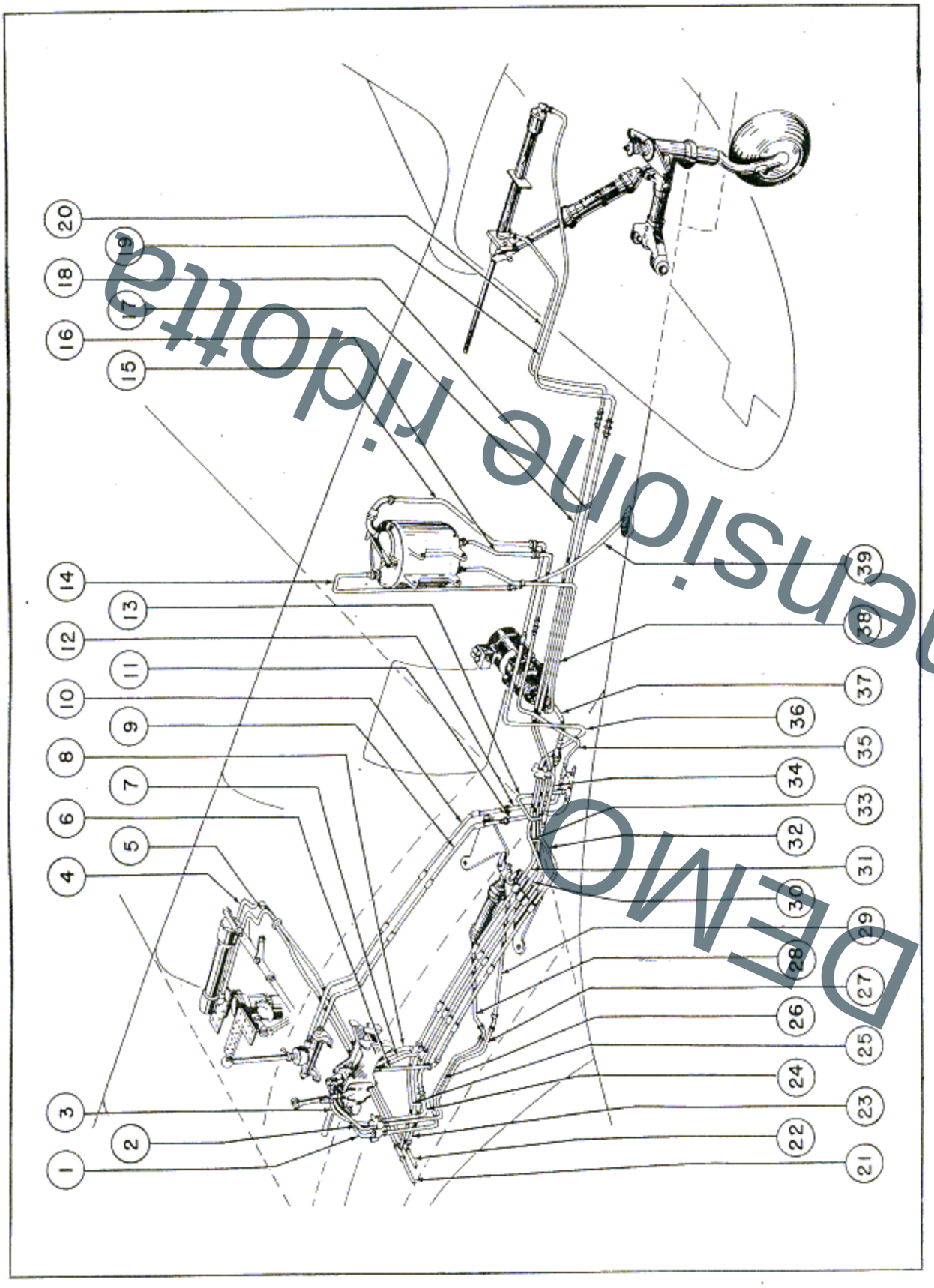


Figure 307—Hydraulic System Tubing Diagram

dimensione fidotta
DEMO

TUBING CHART FOR HYDRAULIC SYSTEM *(Cont'd)*

Ref.	*Part No.*	*OD*	*Wall*	*Length*	*Material*	*Fittings*
22	87-33-902-208	3/8	.035	32	Cu. Si. Br.	75-33-101-CCT-6-2330
23	87-33-902-36	3/8	.035	16-1/4	Cu. Si. Br.	75-33-101-JT-6-2330 75-33-101-CCT-6-2330
24	87-33-902-94	3/8	.035	11	Cu. Si. Br.	75-33-101-HT-6-2330
25	87-33-902-202	3/8	.035	44	Cu. Si. Br.	75-33-101-DT-6-2330 75-33-101JT-6-2330
26	87-33-902-68	5/16	.035	10-3/8	Cu. Si. Br.	75-33-101-FT-5-2330 75-33-CT-6-2330
27	87-33-902-70	5/16	.035	11-1/2	Cu. Si. Br.	75-33-101-FT-5-2330 75-33-CT-6-2330
28	87-33-902-60	5/16	.035	17	Cu. Si. Br.	75-33-101-CT-45-5-2330 75-33-101-ET-5-2330
29	87-33-902-62	5/16	.035	21-1/2	Cu. Si. Br.	75-33-101-FT-5-2330 75-33-101-ET-5-2330
30	87-33-902-26	3/8	.035	61-5/8	Cu. Si. Br.	75-33-101-FT-6-2330 75-33-101-JT-6-2330
31	87-33-902-28	3/8	.035	62	Cu. Si. Br.	75-33-101-FT-6-2330 75-33-101-JT-6-2330
32	87-33-902-24	3/8	.035	54	Cu. Si. Br.	75-33-101-FT-6-2330 75-33-101-JT-6-2330
33	87-33-902-22	3/8	.035	74-1/2	Cu. Si. Br.	75-33-101-FT-5-2330 75-33-101-FT-6-2330
34	87-33-902-72	3/8	.035	12	Cu. Si. Br.	75-33-101-HT-6-2330 75-33-101-JT-6-2330
35	87-33-902-86	3/8	.035	80	Cu. Si. Br.	75-33-101-CT-45-6-2330 75-33-HT-6-2330
36	87-33-902-20	3/8	.035	40	Cu. Si. Br.	75-33-101-HT-6-2330 75-33-101-CT-45-6-2330
37	87-33-902-12	3/8	.035	10	Cu. Si. Br.	75-33-101-CT-45-6-2330 75-33-101-FT-6-2330
38	87-33-902-10	1/2	.035	44	Cu. Si. Br.	75-33-101-CT-45-8-2330 75-33-101-CT-45-8-2330
39	87-33-902-166	1/4	.035	16	Cu. Si. Br.	75-33-101-HT-4-2330 AN823-4

Anti-seize thread lubricant AN-C-53 is recommended for application to fittings in assembling the hydraulic tubing. Apply AN-C-53 so that none can possibly enter the fluid system. Apply sparingly to threads and external surfaces of the tube flares only.

CAUTION

Seal all ports and openings immediately upon disconnecting lines to prevent dirt entering the system.

The following torque values shall be used on tube fittings installed in the hydraulic system of the P-40N airplane when they are assembled with AN-C-53 anti-seize.

TORQUES FOR TAPER THREADS

Nominal Pipe Size—Inches	*Torques—Inch-Pounds*		
	Minimum	*Best*	*Maximum*
1/4	70	150	250
3/8	75	275	315
1/2	90	550	840
3/4	90	750	1400

DEMO dimensione ribotta

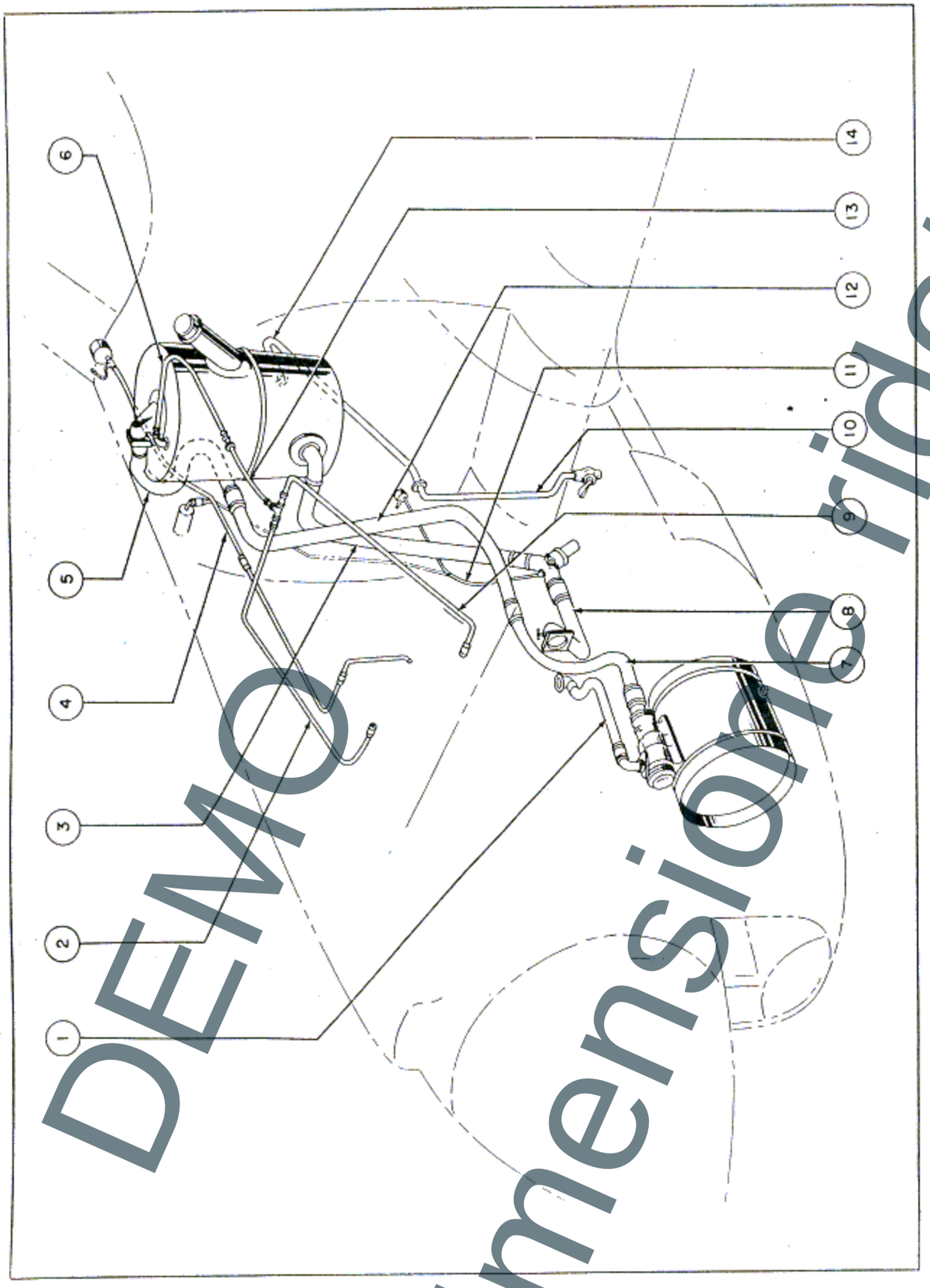


Figure 308—Lubrication System Tubing Diagram

DEMO
dimensione ridotta

APPENDIX I
U. S. A. - BRITISH GLOSSARY OF NOMENCLATURE

U. S. A.	*British*
Accumulator (hydraulic)	Should not be confused with electrical accumulator or battery
Antifriction bearings	Ball and roller bearings
Battery (electrical)	Electrical accumulator
Blade connecting rod	Plain connecting rod
Block test	Bench test under engine's own power
Box-end wrench	Circular-ended wrench (for hexagon)
Cap screw	Setscrew or screw
Check valve (hydraulic)	Non-return valve
Clevis	Fork joint or knuckle joint
Closed spanner—wrench with internal lugs or surface lugs	Ring spanner
Cotter pin	Split pin
Cylinder (hydraulic)	Jack
Dump valve	Jettison valve
Fillister head screw	Cheese headscrew
Flathead screw	Countersunk head screw
Flight indicator	Artificial horizon
Gall	To fret or score
Gasoline (gas)	Petrol
Gross weight	All up weight
Ground (electrical)	Earth
Green run	Endurance test
Gyro horizon	Artificial horizon
Kerosene	Paraffin
Knuckle pin (used on radial engines)	Wrist pin or anchor pin
Lock washer	Spring washer
Manifold pressure	Boost
Oil pan	Sump
Pad	Sometimes used for raised machined surface for mounting accessories, etc.
Palnut	Type of lock nut
Panel, wing—Center of inboard panel	Center section
Outboard panel	Outer plane
Piston pin	Gudgeon pin
Propeller	Airscrew
Recticule (gun sight, etc.)	Graticule
Round-head screw	Cup head screw
Screen	Filter
Setscrew	Grub screw
Ship	Aircraft
Slushing compound	Corrosion inhibitor
Socket wrench	Box spanner
Spanner	C-spanner
Spanner wrench	Ring spanner
Stabilizer—	
Horizontal	Tail plane
Vertical	Fin
Stack	Manifold (inlet or exhaust)
Sylphon	Aneroid
Tachometer	Engine speed indicator
Tag	Label
Test club	Test fan
Tube (radio)	Valve
Turn indicator	Direction indicator
Valve (fuel or oil)	Cock
Weight empty	Tare

DEMO dimensione ridotta

ALPHABETICAL INDEX

DEMO dimensione riotta

DEMO dimensione ridotta

DEMO dimensione riodotta

DEMO dimensione riodotta

DEMO dimensione ridotta

DEMO dimensione ridotta

DEMO dimensione riotta